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THE LIFE HISTORY AND BIOLOGY OF THE TREE-TOAD CHIGGER, TROMBICULA HYLÆ EWING.

H. E. EWING,
Bureau of Entomology, United States Department of Agriculture.

Records of ectoparasites occuring on amphibians are exceedingly rare, and except for the occasional reports of parasitism of frogs by tropical ticks, are all but nonexistent. However, at least one interesting case of such parasitism has been previously studied. Miss Mary Brown reported in 1922 a case of cutaneous infestation of frogs by the larvæ of an acarid which she regarded as a water mite. Although an excellent morphological study was made of the larval instar of the frog-infesting mites, neither nymphs nor adults were obtained, and the biology of the species and its taxonomic affinities remained largely a mystery.

Because of the great rarity of ectoparasitism of amphibians the writer was much surprised to have his attention called to such a case early in the present year (1925) by Miss Doris M. Cochran, of the Division of Batrachians and Reptiles, United States National Museum. The toad species was *Hyla arenicolor*, and the infesting mites were found to belong to the genus *Trombicula*. They have been described (Ewing, 1925) under the name of *Trombicula hylae*.

The infested toads were tree-toads and constituted a part of a lot of about two dozen live specimens of two species of the genus *Hyla*, *H. arenicolor* and *H. regilla*. They had been collected on March 15, 1925, at Barrett Dam, Cottonwood Creek, San Diego County, California, by L. M. Klauber. Although the number of specimens belonging to the two species of *Hyla* were about equal, no mites were found on *regilla*, while nearly every specimen of *arenicolor* was infested.

NATURE OF INFESTATION

More striking than this apparent host preference of the mites for *arenicolor* was their nature of their infestation. Every one of the several score of acarids observed was attached to or imbedded in the ventral surface of the body and appendages of the amphibians (Fig. 1). The ventral portions of the thighs

FIG. 1

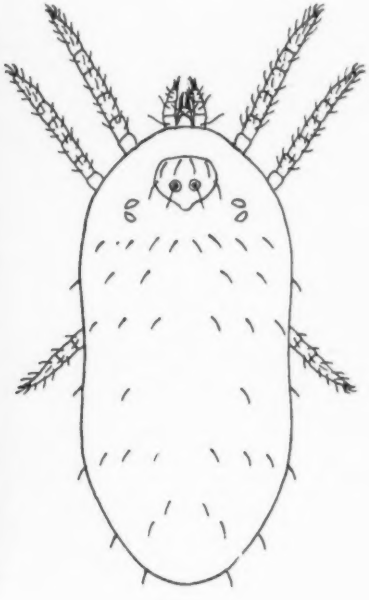

FIG. 2

Fig. 1. Ventral view of a specimen of *Hyla arenicolor* infested with larvæ of *Trombicula hylæ* Ewing, × 2. (Photo by J. G. Pratt).
Fig. 2. Engorged larva of *Trombicula hylæ* Ewing, × 100.

were the most heavily laden, yet no part of the ventral surfaces was exempt. When the hosts were examined under the binocular miscroscope, both alive and dead, it was found that some of the mite specimens were attached purely as external parasites, the method of attachment being similar to that of the known species of *Trombicula*. Other specimens were partly imbedded in the skin. In one instance a fully engorged mite was found

with half of its body sticking above the surface of the skin and half of it below the skin.

Others were entirely below the skin. In a dead frog I dissected out two of these that were fully engorged. The skin proper was torn off and examined with the microscope. It was normal and showed very distinctly the squamous epithelial cells. Just below the skin, between it and the subcutaneous tissue, lay the mites.

Two questions arise in regard to the peculiarities of the method of infestation: Why is it that only the ventral surfaces of the host are parasitized, and how do the mites get under the skin of the host?

It occurred to the writer that the mites might have attached to the ventral surfaces for the simple reason that it was these surfaces of the feet, limbs and body that came in contact with the surfaces on which the mites were found. Yet could it not be that the repellent glands of the back were effective in preventing an infestation of that part of the host?

In regard to the penetration of the skin it was found that the chelicerae were particularly adapted for penetrating and holding. The tip of each was provided with a recurved, toothed, knob-like structure quite different from that of any of the known *Trombicula* larvæ. Aside from this peculiarity, the mouth parts were devoid of any boring or tearing structure, and were in fact typical for the genus *Trombicula*.

The writer is of the opinion that the mites enter the pores of the mucous glands, and when in the interior of these saccular structures engorge successfully, but in doing so "seal their doom" by becoming too large to pass out through the pores they entered Because the mites were observed several days after attachment it could not be definitely determined whether the unengorged larvæ had entered one of the mucous pores or had penetrated the the cells of the skin itself.

A microscopical examination of the skin of *Hyla arenicolor* shows the diameter of the mucous pores to be much less than the estimated size of an unengorged larva, yet with the type of chelicerae that *T. hylæ* possesses it may be possible that the elasticity of the tissues would permit sufficient distension to allow the mite entry.

LIFE HISTORY.

On March 31st, 1925, one infested frog was placed in a breeding jar provided with sand at the bottom over which was placed a thin layer of turf. Four frogs were placed in a jar under similar conditions except that instead of turf a layer of moss-covered earth was provided. The frogs were given insects as food from day to day and most of these they relished very much, also the jars were kept quite moist.

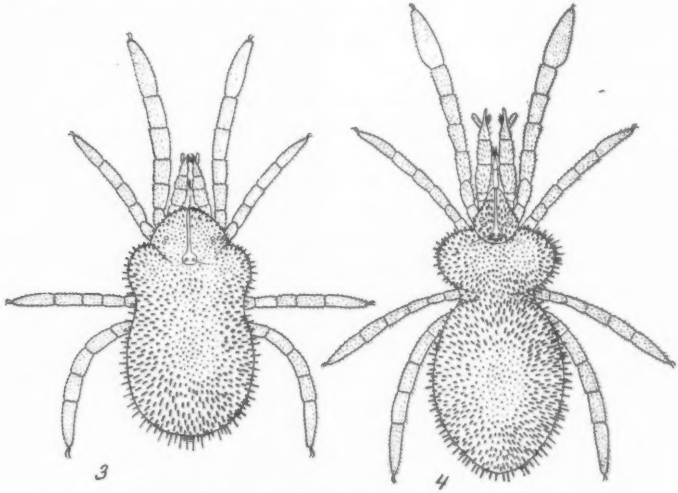

Fig. 3. Nymph of *Trombicula hylæ* Ewing, × 80. (Drawing made of a specimen reared from larva that infested skin of *Hyla arenicolor*.)
Fig. 4. Adult of the tree-toad chigger, *Trombicula hylæ* Ewing, × 80. (Drawing made of an adult reared from *Hyla arenicolor*).

For several days after March 31 there appeared to be no dropping of the parasites. On April 11 one frog, in the cell containing four, was found dead. An examination of this specimen on the eleventh, just four days less than a month after it had been collected in California, showed it to be heavily infested with chiggers.

Quiescent larvæ were first observed in the soil on April 13. On this date six larvæ were found at the following depths: One at 9 mm., one at 15mm., two at 17 mm., and two at 19mm.

On April 14 two more frogs were dead.

The first nymph to be found was seen on April 22. It was active but was yet near its cast larval skin. It was killed and mounted for study. Later, on the same day, a second nymph was observed in the act of emerging. When it was only partly free from its old skin it was killed. The next day, April 23, the third nymph was observed, and from that time on others came out at different intervals. Although many nymphs were thus obtained only a single adult was procured. This one was taken on June 16 from the cell that had previously contained the four tree-toad hosts.

LENGTH OF PARASITIC PERIOD.

Instead of the larvæ of this species of *Trombicula* engorging in a few days, as do those of other species on mammalian hosts, evidently these larvae require weeks, not days, to engorge. In every instance the hosts upon dying were found to harbor still several individuals. And in one instance a toad which was kept until July 6, by Miss Cochran, had several chiggers attached. These chiggers had remained attached to their host for over three months!

When the dead frogs were examined for attached mites, it was found that those that had remained attached unduly long were either partly or wholly imbedded under the skin.

Yet these subcutaneous specimens engorged normally, and remained alive for many days after their brothers in a more favorable situation had detached. However, in no case did the fully engorged, subcutaneous specimens transform into nymphs in their positions under the skin. All of these observations point to skin penetration as a habit somewhat erratic and probably diasatrous to the individuals concerned.

HABITS OF NYMPHS AND ADULT.

Miss Mary Brown believed that mites which she found parasitizing *Acris gryllus* and *Rana pipiens* were water mites. A study of her drawings, however, shows that the species she worked with was very probably a harvest mite (family Trombidiidae). Yet the fact that the hosts are more or less aquatic suggests that the free stages of the mite may possibly be aquatic.

Observations on the live nymphs and adult of *Trombicula hylæ* Ewing, showed that these instars are terrestrial. They live in or upon the soil, and apparently in a manner similiar to that

of the nymphs and adults of the common chigger, *Trombicula irritans* (Riley). *Trombicula irritans* is a scavenger or saprophyte in its nymphal and adult stages, living upon the feces of various arthropods, the juices of decaying plants, etc.

In the soil provided for the transformations of *Trombicula hylæ* the number of minute arthropods was so small that it is not believed that the nymphs could have subsisted entirely on them. Also, no instance was observed of nymphs attacking any of the arthropods present. Apparently, therefore, they were scavengers or feeders upon decaying organic matter.

DESCRIPTION OF NYMPH.

Nymphs of *Trombicula hylæ* (Fig. 3) are very similar in color, shape and general appearance to those of *T. irritans*. They have the strong body constriction at the point of junction of the cephalothorax with the abdomen, a character that is common to all Trombiculas. Likewise the front legs are enlarged, the body setæ strongly pectinate and the palpi slender and strongly clawed. Also, the nymphs of this species have but two accessory claws or spines in addition to the chief or terminal palpal claw, which is a condition of the nymphs of both our common chigger, T. *irritans*, and the Japanese chigger, *T. akamushi*. The adult of *hylæ*, however, like the adults of *irritans* and *akamushi*, has three of the accessory claws or spines.

T. hylæ nymphs differ from most if not all the known nymphs of the genus in having four instead of two eyes. These eyes are sessile and in the form of a double pair. Also the nymphs are longer (0.86 mm.) in proportion to their width (0.41 mm.) than most of the nymphs that have been observed in other *Trombicula* species.

DESCRIPTION OF ADULT.

Only two differences between the adult (Fig. 4) and nymphal instars were detected. The adult is decidedly larger (length, 1.03 mm.; width, 0.46 mm.) than the nymph, and each palpus of the adult has three accessory claws or spines instead of the two that are present in the nymphs. It may be that there is a difference in the number of the genital suckers in the two instars, but those of the single adult specimen obtained could not be counted because of insufficient clearing of the specimen.

SUMMARY.

1. For the first time, it is believed, nymphs and adults have been reared from parasitic mite larvæ obtained from amphibian hosts.

2. The nymphs and adults of the mite larvæ found on and under the skin of the tree-toad, *Hyla arenicolor*, belong to the family Trombidiidæ and the genus *Trombicula*.

3. No evidence was found that *Trombicula hylæ* is in any way aquatic, but on the contrary the nymphal and adult instars were shown to be terrestrial and soil-inhabiting.

4. This demonstration that the larvæ infesting *Hyla arenicolor*, are true chiggers, *i.e.* Trombiculas, is very significant in throwing light on the perplexing biological relations of the common chigger, and has already lead to the establishment of the fact (Ewing, 1926) that our common box-turtle, *Terrapene carolina carolina*, is an important natural host of the chigger that attacks man. From the common box-turtle both nymphs and adults have been reared.

5. The establishment of the fact that two North American chiggers naturally parasitize reptiles (Ewing, 1921, 1926 and Miller, 1925) and amphibians should indicate the possibility of similiar infestation by other species, possibly even disease-carrying species.

6. A complete study of the possible amphibian and reptilian host relationship of all man-infesting chiggers is very desirable from the standpoint of the etiology of certain tropical and sub-tropical infections.

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THE EXTERNAL ANATOMY OF THE ADULT OF HOPLOCAMPA HALCYON NORT. (HYMENOPTERA, TENTHREDINOIDEA).

R. D. Bird,
Department of Zoology, University of Manitoba, Winnipeg, Man.

Although the sawflies are a large and important group of the Hymenoptera little anatomical work has been done on them. A study of the external anatomy of *Hoplocampa halcyon* Nort., a common sawfly borer in the fruit of the saskatoon, *Amelanchier spicata*, was undertaken with the hope of clearing up a few points of the morphology of the superfamily. This species belongs to the *Hoplocampinæ*, a subfamily of the *Tenthredinidæ*.

LITERATURE

The literature on insect anatomy that has any bearing on the species studied is rather scanty. MacGillivray (1916), Marlatt (1896) and Smulyan (1923) give a brief discussion of the external structures of sawflies used in classification, while Rohwer (1911) gives those of the genus *Hoplocampa*. Martin (1916) discusses the sclerites of the thorax and cervical region, and Crampton (1921, 1925) those of the head and mouth parts of insects in general. MacGillivray (1912) describes the maxillae of Hymenoptera and (1906) gives a detailed study of the wings of *Tenthredinoidea* according to the Comstock-Needham system. Probably the best detailed anatomical study of a Hymenopteron is that of Snodgrass (1925) on the honeybee.

The genitalia on account of their systematic value have been the subject of several papers. The most extensive work on this subject is that of Boulangé (1924) in which the male genitalia of many species of sawflies are described in detail. Shorter works on the male genital apparatus are those of Crampton (1919, 1923). Morice (1911) describes the saw of the female in several species and its mode of action. Newel (1918) studies the genitalia of insects from a comparative point of view, and Parrott and Fulton (1915) figure and briefly describe the genital apparatus of both sexes of *Profenusa collaris* MacG.

I would like to express my indebtedness to Prof. C. H. O'Donoghue of the Dept. of Zoology, Univ. of Manitoba, for many helpful suggestions in preparing the following notes and to Dr. C. G. Crampton of the Massachusetts Agriculture College, Amherst, Mass. for reprints of his papers and many suggestions in correctly naming the parts.

The larger parts of the specimens were studied under a binocular microscope. The appendages were removed, cleared in xylol, mounted in balsam and studied with the monocular. For the head capsule and thorax it was found necessary to remove the non-chitinous parts by boiling in a 5% solution of potassium hydroxide. The heavily pigmented parts of the thorax were bleached in chlorine water.

All the drawings were made with the aid of the camera lucida and at the magnification stated. Pigmented areas are indicated in black or heavy stippling, membrane in light stippling and non-pigmented areas are left white.

The nomenclature proposed by Dr. Crampton has been followed as closely as possible. The cells and veins of the wings are named according to the Comstock-Needham system used by MacGillivray (1905).

The Head.

(Figs. 1, 3, 4, and 7).

The head of the male is slightly smaller than that of the female corresponding to the smaller size of the body and has the pigmented areas darker and more extensive.

The outline of the head capsule seen from the front (Fig. 7) is approximately a square, but with rounded corners and sides; from above (Fig. 3) that of a short thick chevron; from the side (Fig. 1) an oval.

The walls of the head capsule of this sawfly, like those of the honeybee, are not marked with sutures to any extent, but the cranial areas may easily be made out. The vertex or postocellar area (v) is marked off by distinct paracranial sutures or vertical furrows (v. f.). The front (f) is rounded on each side of the median line to the antennal furrows (a. f.). The remaining two-thirds of the distance to the compound eyes (e) is flattened. The genæ (g) and postgenæ (pg) are short. The supraclypeal area is uniformly convex. Just anterior to the vertex are three ocelli (o.) whose dorsal margins are almost touched by the ocellar furrow (o. f.). One is just below the median line and one just below each antero-lateral corner of the vertex. The area between them and the ocellar furrow is heavily pigmented. The median fovea is wanting. The antennal socket (a) is much larger than the base of the antenna. It is oval in outline, save for a peg-like projection from the latero-ventral border, with which the antenna is articulated. The occiput

(oc.) is bent in a wide "V." The foramen magnum (f. m.) is elongated vertically and is bounded at a little distance from its edge by a pigmented chitinous ridge (c. r.), which is much higher near the ventral border, where the apophyses of the lateral cervical sclerites articulate with it. The neck muscles are attached to the more dorsal part of the ridge.

The antennæ (Fig. 5 and Fig. 7, an.) are nine-jointed, cylindrical and somewhat heavily pigmented. The first two joints are about one-half the length of the third, which is the longest, the remainder being slightly shorter. The whole is covered with numerous very short hairs.

The compound eyes (e) are oval, black and prominent.

The clypeus (c) is marked off by a distant clypeal suture (c. s.). It is four times as long transversely as vertically and has a median wide shallow curved indentation.

The labrum (l) is much smaller than the clypeus, to the distal end of which it is attached. The labrum and distal half of the clypeus are hairy.

The mandibles (m) end in a long curved point and bear a deep notch and tooth about half way along the cutting edge. A wide notch is situated proximally to the tooth and two small denticles distally. The exact shapes of the tooth and denticles vary considerably in individuals and even in the same specimen, as may be seen in the figures. The distal end on the mandible is heavily chitinized and of a dark brown color. Proximally to the chitinized part there is a patch of hair on the outer side.

The maxillæ (Fig. 9) bear a six-jointed palp (p.). The cardo (ca.) is a small rectangular sclerite at the proximal end of the rhomboidal stipes (s.). Only one segment of the galea (ga) is distinct, the other, like the palpifer, being completely fused with the stipes. The lacinia (la) is triangular in outline and passes without any sign of a suture into the stipes. The palps, galea, lacinia and part of the outer edge of the stipes are hairy.

The labium (Fig. 2) has three jointed palps and an elongated palpiger (lp.), which appears like the first joint of the palps. The mentum (me) is a cylinder almost as long as broad, but the submentum (sm) is reduced to a small, little chitinized plate. The glossæ, fused to form a single plate, and the paraglossæ are flattened, triangular structures, which like the palps and palpigers are hairy.

The Thorax and Cervical Sclerites.

(Figs. 16, 19, and 20).

The pronotum (pn) extends as a narrow collar-like sclerite around the anterior end of the thorax from the front edge of one fore wing to that of the other and expands into a triangular expansion passing postero-ventrally along the anterior edge of the basalar plate. It is divided by an indistinct suture into an anterior, antepronotum (ap) and a posterior postpronotum (pp). This division is purely secondary and has no reference to the division of the mesonotum and metanotum into scutum and scutellum as indicated by Crampton, Snodgrass and others.

The mesonotum is composed of five median sclerites, which, naming from the front are respectively the prescutum (pr), scutum (sc), scutellum (ms), posttergite (po), and postscutellum (pos), and two pairs of paired sclerites, the paratergites (pt) and the parascutella (ps). On the antero-lateral margins of the scutum (sc) near the tegula (t) are the narrow paratergites (pt) and on its postero-lateral margins are the triangular parascutella (ps), which end anteriorly in rounded projections for attachment to the fore wings. The mesoscutellum (ms) appears as a large triangular sclerite wedged in between the parascutella and into the scutum so as to almost reach the backward projection of the prescutum (pr). Just behind the mesoscutellum is the posttergite (po) of the mesonotum, which is separated from the large postscutellum (pos) by a narrow membrane as in other insects. The postscutellum is continued internally under the succeeding segment of the thorax and the first tergum of the abdomen as the heavily pigmented phragma (Fig. 17), which is indicated in the figures by dotted lines.

The metanotum is composed of four median sclerites, but the prescutum is hidden, so that the first visible sclerite is the large metascutum (met) on which are situated the oval, membraneous cenchri (ce). Lateral to the metascutum are triangular sclerites that correspond to the parascutella of the metanotum and just behind it is the metascutellum (ml) which is separated from the metapostscutellum (mp) by a membrane as in lower insects. The metapostscutellum is closely associated with the first abdominal tergite and connects laterally with the epimeron (ep).

In the lateral and ventral views of the thorax may be seen the lateral cervical sclerite (n) which is fused at its proximal end with the prothoracic episternum (es) and terminates at its distal end in the apophysis (as), which articulates with the chitinous ridge on the side of the foramen magnum.

The prothoracic episternum (p. es) is separated by a narrow suture on its dorso-proximal edge from the proepimeron (pe) and on its ventro-proximal edge from the prosternum. Between these two latter sclerites the procoxa is articulated, but is separated by a wide membrane (mm) from both, save ventrally, where it is closely approximated to the prosternum.

The very large mesothoracic episternum (m. es) is completely fused with the sternum (st) and the two lateral plates thus formed meet in the midventral line. At the dorsal end is a triangular basalar sclerite (b) and at the ventral end, the coxa (cx) and the furcasternite (fs). The mesothoracic epimeron (m. ep) is divided into an upper and lower region, the anepimeron (ae) and the katepimeron (k). The lateral region of the postscutellum is divided into an upper (u) and lower (l. p.) postalar plate. At the base of the wing is an indistinct subalar plate (s. a.).

In the metathorax the episternum is divided into an upper sclerite, the anepisternum (am) and a lower, the katepisternum (ke) which unites with the sternum and at the ventral edge of this is the coxa and furcasternite. The epimeron is connected with the lateral margin of the

postscutellum. As in the mesothorax there is an indistinct subalar plate (sa).

The spiracles (sp) occur as indicated, one on each side between the prothorax and mesothorax, and mesothorax and metathorax.

The Legs.

(Fig. 6).

The legs are long and slender and do not differ noticeably in the two sexes. The pro- and mesothoracic legs are the same length, namely, 3.5 mm., while the metathoracic legs (Fig. 6) are 5 mm. long. The coxæ (cx) are subconical and lie close together. The trochanters (tr) are somewhat larger at the distal than the proximal end. The femurs (fe) have a small proximal portion marked off by a distinct annulus. The tibia (ti) of each leg is slightly longer than the femur and is armed with two apical spines (ai). The tarsus (ta) is slightly longer than the femur and is five-jointed. The first joint is twice the length of the second; the second almost twice that of the third and the third of the fourth. The fifth joint is as long as the third and fourth together. Each of the first four joints of the tarsus bears an arolium (ar) at its apex. The fifth has two claws between which there is a pulvillus (pu). The tibiæ and tarsi are sparsely covered with fine hairs.

The terminal structures of the foot may best be understood by reference to Figures 10, 14, and 19.

The claws (cl) are strongly curved downward at the tip and bear a small rounded knob-like tooth (to) on the ventral side about one-quarter the distance from the distal end. On the inner side opposite the tooth each bears a long stiff hair and on the outer side behind the tooth two slightly shorter ones. The proximal half is covered with numerous small hairs. The claws articulate with a small sclerite on the dorsal side, the ungifer (un).

The adhesive organ or pulvillus is situated between the claws and consists of a terminal dome-shaped structure or arolium (ar) and a stalk around which there are several sclerites. On the dorsal surface is a large rectangular sclerite, the orbicula (or), which bears two long hairs on each side about one-third of the distance from the distal end and a number of small ones all over its surface. At its base it is articulated with the ungifer. At the base on the ventral surface is an elongated plate, the ungitractor (ut) to which muscles in the fifth tarsal joint are attached. Proximal to the ungitractor is a large sclerite covered with numerous small hairs, the planta (pla) (MacGillivray). Around the base of the arolium runs a narrow ring-like sclerite, the camera (cm) (MacGillivray).

The Wings.

(Figs. 11 and 13).

MacGillivray (1905) has outlined a classification of the Tenthredinoidea on the basis of the wing venation. He has divided the superfamily into two groups, (1) the *generalized Tenthredinoidea*, to which belong the families Xyelidæ and Lydidæ and (2) the *specialized Tenthredinoidea*, in which he places the remainder of the superfamily. The

specialized forms he again subdivides into two groups, (1) the cell R_4 group in which he places the Blasticotomidæ and the Tenthredinidæ, and (2) the cell R_5 group to which belong the remainder of the specialized forms.

The Tenthredinidæ are further divided into the *generalized* and the *specialized* forms. The latter are grouped according as to whether the anal cell is conserved or lost. The forms which retain the anal cell may lose or conserve the second anal vein and the forms that lose the second anal vein may have the second anal cell reduced by atrophy or coalescence and if by atrophy conserve or lose the costal area. If the costal area is conserved the radial cross-vein may be conserved or lost. The forms in which the radial cross-vein is conserved are represented by the subfamilies Hoplocampinæ and Dineurinæ.

To sum up then, the Hoplocampinæ belong to a specialized group of the Tenthredinidæ, which are specialized Tenthredinoidea and are characterized by conserving the anal cell, losing the second anal vein by atrophy and by conserving the costal area and radial cross-vein.

For the characteristics of the wings of the Hoplocampinæ we can do no better than quote MacGillivray:

> "The Hoplocampinæ and the next subfamily (Dineurinæ) represent a series in which the anal veins have been modified before the loss of the radial cross-vein. In this subfamily the costal area is broad with the free part of Sc_1 distinct. The area between R_1 and R_3 is very broad, the radial cross-vein is long, straight and slightly oblique. The area between the base of the stigma and the base of the radial sector has been chitinized so that it appears as a part of the stigma. The medio-cubital cross-vein is joined to R+M distinctly before the origin of media, usually near the free part of Sc_1. The free part of M_4+Cu_1 is joined to the cell M_4 near its middle. The anal cells are contracted for a short distance in *Hoplocampa* and for a considerable distance in *Hemichroa*. In the hind wings the anal lobe is larger, the venation is of the usual type."

As regards *Hoplocampa halcyon* itself, little can be added to the above quotation. The characters which specifically differentiate this species from the other members of the genus are the shapes of certain cells in the radial area and the anal cell of the fore wings. These can be seen in Figure 8 and their diagnostic value appreciated by reference to Rohwer (1911). It might be added that at the base of the fore wing there are three axillaries (ax) and a median plate. On the costal margin of the hind wings are a row of 9 hamuli which fasten into a fold on the inner margin of the fore wings. The membranous parts of the wings are sparsely covered with fine hairs.

The Abdomen.

(Figs. 18, 22 and 23).

The abdomen, as in all sawflies, is not constricted at its junction to the thorax. In the female there are nine large terga and in the male eight large terga and a very small ninth, which is completely hidden by

the eighth. In addition there is in both sexes a small sclerite (x), to which the club-like, unsegmented cerci (cc) are attached. This may represent the fused tenth and eleventh tergites found in lower insects (Crampton, 1919). The first tergite, which has no corresponding sternum, is really the second. A pair of spiracles occur in each segment except the ninth, one near the lateral margin of the tergum on each side. There are only six sterna in the female, the remainder being modified to form the ovipositing apparatus. In the male there are eight sterna, e. g., second to ninth. The eighth is very small, but the ninth is larger than any of the others. It covers the ventral side of the genitalia and is called the hypandrium. The claspers and penisvalvae may be seen projecting dorsally. In the female posterior to the sixth sternum (actually the seventh abdominal sternum) is the ovipositor sheath made up of three sclerites, a basal triangular one (os) which is divided into two halves by a suture and two pairs of long narrow ones that enclose the saws.

The External Genitalia.

(Figs. 21 and 24).

(a) *Female.* (Fig. 24). The external genitalia of the female consists of two saw blades, the dorsal edges of which work in the ventral edges of two blade-like guides in the manner of a sliding tongue and groove joint. The saw and guides are enclosed in a sheath composed of three parts, (os_1, os_2, os_3). The apex of the sheath which is of specific importance is figured, (Fig. 15). The saws and their respective guides lie side by side the one being to the other as the right to the left. Each saw (Fig. 24, sw) is one millimeter in length and 0.105 mm. in width at the proximal end, from which it gradually tapers to a point at the distal end. Each is slightly concave and smooth on the side nearest its mate, the opposite, i. e., outer, side being slightly convex and annulated. The whole is bent ventrally in the arc of a large circle, save the tip, which bends slightly dorsally. The teeth are arranged on the convex side and the ventral edge in a series of 14 sets and together with the ridges on which they are borne give the saw its ringed appearance. The sixth set from the proximal end is the most perfect. It consists of a row of denticles along the side, attached so that they point toward the proximal end of the blade and an anvil-shaped tooth on the ventral edge. The dentacle nearest the ventral tooth is the largest and appears to be related to it so that the two form a pair. The remaining sets of teeth are imperfect modifications of the above. In sets 7 to 14 the lateral dentacles become less pronounced. The large ventral one continuing until the thirteenth, but the others disappearing on the ninth. The ventral tooth also becomes progressively less pronounced. In sets five to one the lateral dentacles remain perfect, but the ventral tooth progressively loses its anvil-like appearance and is almost entirely absent from the first. From both the dorsal and ventral edges of the saw a chitinous band runs back to which muscles are attached.

The guides (Fig. 24, s, g) are slightly concavo-convex, but bear no teeth and only twelve annulations, marked by chitinous bands. At the

proximal end they are 0.109 mm. in width. The edges run parallel until the distal fifth then the dorsal edge bends ventrally so that the blade ends in a point. They also bear chitinous projections for attachment to muscles, the dorsal one having a curious pointed projection at its junction to the blade.

(b) The male genital armature (Fig. 21) is a chitinous organ, cylindrical in shape and somewhat flattened dorso-ventrally. It is drawn up into the distal end on the abdomen where it is covered ventrally by the large sternum of the ninth abdominal segment. The anterior edge is oblique, the dorsal part projects forward and is bounded by a chitinous ring, the gonocardo (gc), which is pointed at its anterior extremity. The main body of the organ consists of two large lateral valves, the gonostipes (gs), which meet ventrally, but dorsally are only connected by a membrane, the exact boundaries of which are not distinct as its edges become chitinous and grade into the valves. At the posterior end of each lateral valve is another chitinous plate, the claspers, genital forceps or gonopods (gp). The volsellæ (vo) bear a blunt point directed downwards and outwards. Anteriorly they grade into the dorsal membrane. On each side of the median line, just ventral to the volsellæ are two elongated structures, the penisvalvæ (pv) that serve as a penis. The end of the ejaculatory duct is chitinized and forms the verga (ve) which projects from the dorsal surface of the penisvalvæ near the distal end as a long spinous process. Their adjoining surfaces are concave so that when pressed together they form a tube. Proximally they are extended as rods under the dorsal membrane where they are attached to muscles.

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EXPLANATION OF PLATES XX AND XXI.

Pigmented areas are indicated by black or heavy stippling, membrane by light stippling and non-pigmented areas by white. All drawings were made with the aid of the camera lucida at the magnification indicated.

Fig. 1. Head capsule of female seen from the side. ×25.
Fig. 2. Labium of female. × 25.
Fig. 3. Head capsule of female seen from above. ×25.
Fig. 4. Head capsule of female seen from behind. × 25.
Fig. 5. Left antenna of female. ×25.
Fig. 6. Metathoracic leg of female. × 25.
Fig. 7. Head of female seen from the front. ×25.
Fig. 8. Hamuli on costal margin of hind wing. × 47.
Fig. 9. Left maxilla of female. ×25.
Fig. 10. Lateral view of the terminal structures of the foot. ×10.0
Fig. 11. Left fore-wing of female. ×23.
Fig. 12. Dorsal view of the terminal structures of the foot. ×100.
Fig. 13. Left hind wing of female. ×23.
Fig. 14. Ventral view of the terminal structures of the foot. ×100.
Fig. 15. Apical portion of distal sclerite of saw sheath. ×50.
Fig. 16. Lateral view of thorax of female. ×25.
Fig. 17. Lateral view of mesopostscutellum and phragma. ×50.
Fig. 18. Ventral view of abdomen of female. ×25.
Fig. 19. Dorsal view of thorax of female. ×25. The white rectangles in median line back of *ms* are postergite, postscutellum, and metascutellum; the lateral rectangles, metascutum and metapostscutellum; the ovals, cenchrus.
Fig. 20. Ventral view of thorax of female. ×25.
Fig. 21. Dorsal view of male genitalia. ×25.
Fig. 22. Lateral view of abdomen of male. ×25.
Fig. 23. Lateral view of abdomen of female. ×25.
Fig. 24. Saw and guide of female. ×50.

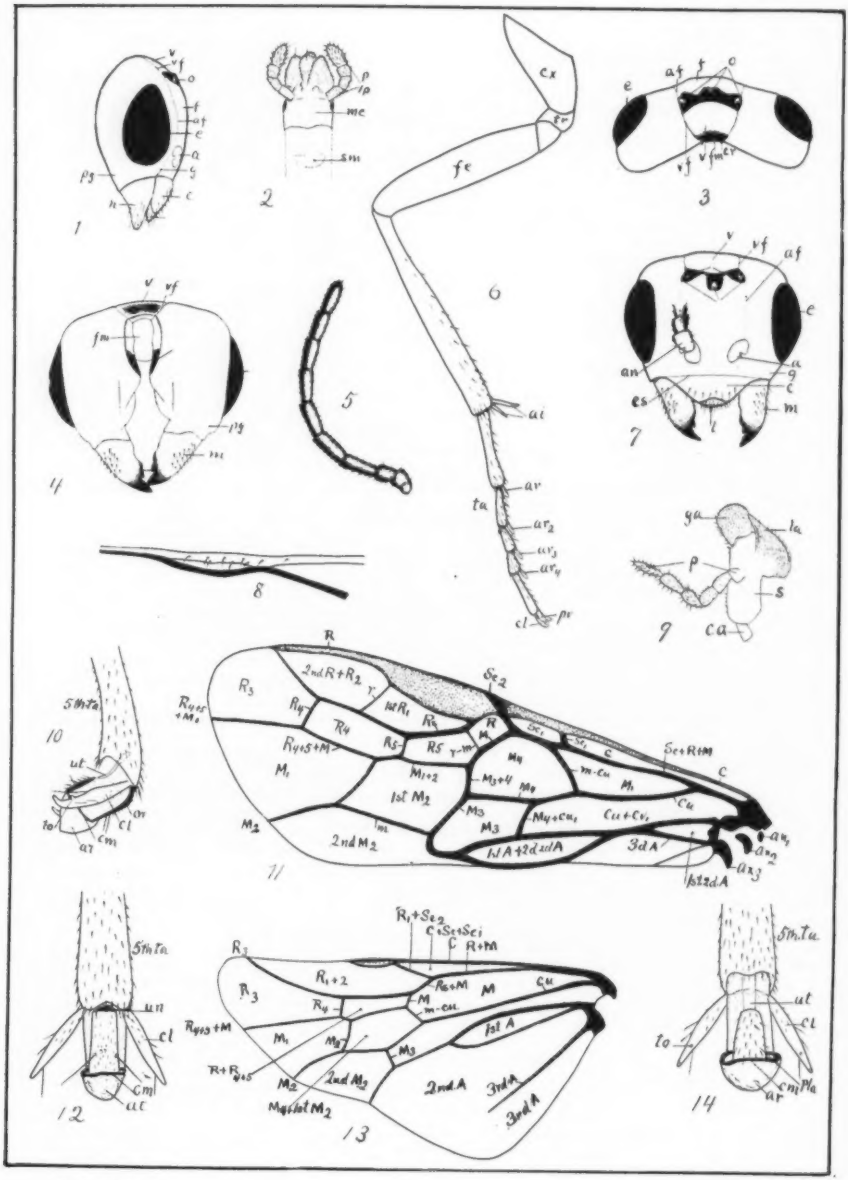
LIST OF ABBREVIATIONS.

a.....antennal socket.
ae.....anepimeron
af.....antennal furrow
a. i.....apical spine
am.....anepisternum
an.....antenna
ap.....antepronotum
ar.....arolium
as.....apophysis
ax.....axillary
b.....basalar sclerite
c.....clypeus
ca.....cardo
cc.....cercus
ce.....cenchrus
cl.....claw
cm.....camera
cr.....chitinous ridge
cs.....clypeal suture
cx.....coxa
e.....compound eye
ep.....epimeron
es.....episternum
f.....frons
fs.....furcasternite
fe.....femur
fm.....foramen magnum
g.....gena
ga.....galea
gc.....gonocardo
gp.....gonopod
gs.....gonostipes
h.....hamuli
ha.....harpes
k.....katepimeron
ke.....katepisternum
l.....labrum
la.....lacinia
lp.....lower postalar sclerite
m.....mandible
m. ep..mesothoracic epimeron
me.....mentum
met.....metascutum
m. es..mesothoracic episternum
ml.....metascutellum
mm.....membrane
mp.....metapostscutellum
ms.....mesoscutellum

n.....cervical sclerite
o.....ocellus
oc.....occiput
of.....ocellar forrow
or.....orbicular
os.....sclerite ovipositor sheath
p.....palp
pa.....paraglossa
pe.....proepimeron
p. es....prothoracic episternum
pg.....postgena
pl.....palpiger (lp of Fig. 2)
pla.....planta
pm.....postepimeron
pn.....pronotum
po.....posttergite
pos.....postscutellum
pp.....postpronotum
pr.....prescutum
ps.....parascutellum
pt.....paratergite
pv.....penisvalvae
pu.....pulvillus
a.....sternites
s.....stipes
sa.....subalar plate
sc.....scutum
sg.....saw guide
sm.....submentum
sp.....spiracle
st.....sternum
sw.....saw
T.....tergites
t.....tegula
ta.....tarsus
ti.....tibia
to.....tooth
tr.....trochanter
u.....upper postalar sclerite
un.....ungifer
ut.....ungitractor
v.....vertex
ve.....verga
vf.....vertical furca
vo.....volsella
x.....fused tergite of 10th and 11th abdominal segments.

Wing Abbreviations.

1st A..First anal vein.
2nd A..Second anal vein.
3rd A..Third anal vein
C.....Costa
Cu.....Stem of cubitus
Cu_1.....First branch of cubitus
M.....Stem of media
m.....Median cross-vein
M_2.....Second branch of media
M_3.....Third branch of media
M_4.....Fourth branch of media
M_{1+2}....Stem of the first and second branches of media.
M_{3+4}....Stem of the third and fourth branches of media
$M_{4+}Cu_1$.Combined fourth medial and first cubital branches.
$M_{1+}R_{4+5}$Combined first medial and fourth and fifth radial branches
m-cu....Medio-cubital cross-vein
R.....Stem of radius
r.....radial cross-vein
R_1.....First branch of radius
R_2.....Second branch of radius
R_3.....Third branch of radius
R_4.....Fourth branch of radius
R_5.....Fifth branch of radius
Rs.....Radial sector
R+M..Combined stems of radius and media
r-m....Radio-medial cross-vein
Sc.....Stem of Subcosta
Sc_1.....First branch of subcosta
Sc_2.....Second branch of subcosta
Sc+R+M..Combined stems of subcosta, radius, and media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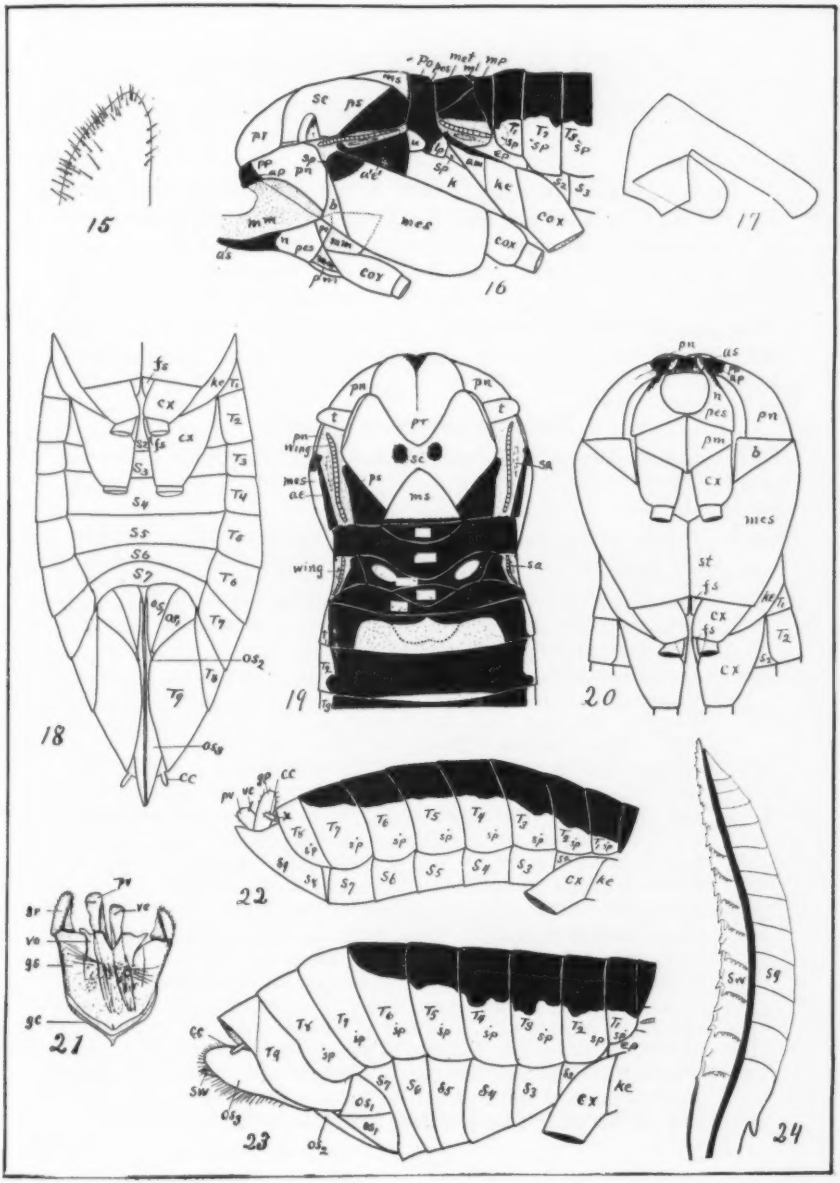
R. D. Bird



R. D. Bird

A NEW NOTONECTA FROM ARABIA.

H. B. HUNGERFORD,
University of Kansas.

In a collection of insects sent to me for determination by Dr. W. E. China, of the British Museum, were two specimens of a large backswimmer from Arabia. Dr. China wrote that the specimens appeared to him to be undescribed. I was inclined at first to ascribe them to *N. violacea* Kirkaldy. A comparison with Kirkaldy's type, however, convinces me that these two female specimens represent an undescribed species.

Notonecta arabiensis sp. new.

Size: Length, 16 mm.; width across the eyes, 4 mm.; width across the thorax, 6 mm.

Shape: Robust.

Color: Head, pronotum, connexivum and limbs yellow. Scutellum black, rear margin of pronotum somewhat darkened. Apical portion of wing membrane dark, remainder of membrane, corium, and clavus brick red with some faint irregular blackish blotches. Venter blackish, midventral keel slightly and abdominal margins plainly yellow.

Structural characteristics: Head short. Eyes not close together. Vertex: synthlipsis: : 19 : 10. Pronotum arched, lateral margins straight, not strikingly ledged. Scutellum longer than elytral suture. Membrane more than twice as long as elytral suture. Legs stout. Mesotrochanter rounded, not spurred.

Described from two females taken in Arabia and belonging to British Museum. These are designated as Holotype and paratype. It is to be hoped that male specimens may be found to enable us to figure the male genital capsule.

Comparative notes: These specimens are of the same size and color as *N. violacea* Kirkaldy. From this species they differ however in having a broader shorter head, wider synthlipsis, and less flattened lateral margins of pronotum as seen from above. Shorter blunter mesofemoral spur. No prominence on caudal margin of mesotibia just distad to femoral spur when the limb is flexed. *Notonecta violacea* Kirkaldy is provided with one. The last abdominal sternite of female is not conspicuously constricted near its tip as in *N. violacea* Kirkaldy. I have before me Kirkaldy's type, a male from Catcin Cauri, Birmania.

THE SO-CALLED OCCIPITAL SUTURE IN THE TRICHOPTEROUS LARVÆ AND IN OTHER ORDERS.*

JOSEPH KRAFKA, JR.,
University of Georgia, Athens.

The larvæ of the Leptoceridæ present a pair of sutures found in no other family of the Trichoptera. These sutures pass from the dorsal margin of the occipital foramen, laterad and cephalad to a position between the eyes and the antennæ where they meet the ends of the epicranial arms by a sharp bend upwards, (Figs. 1–4). The presence of these sutures in this single family of Trichoptera, correlated with the hypothesis that the Leptoceridæ represent the stem form in this order, (Krafka, '23) would indicate them to be of considerable phyletic importance.

The "occipital suture" has given anatomists considerable trouble because of its tendency to shift and become obsolete. It is variously represented in the Orthoptera and the Eupplexoptera, where it divides the genea from the post-genea, but becomes obsolete on the vertex. (Yuasa, '19). (Figs. 6, 10, 12, 15). A suture is present in somewhat the same position in the larval Tenthredinidæ, (MacGillivray, '13), (Fig. 14), and can likewise be recognized in the Neuroptera, (Figs. 16 and 17). Furthermore, the genea themselves offer some difficulty, being considered distinct sclerites of protocerebral origin, (Riley, '04), or of mandibular origin, (Crampton, '21), or as representing merely the basal portion of the vertex, (MacGillivray, '23).

The conditions offered by Anisolabis maritima, interpreted on the basis of the conditions in the Bar-eyed mutant of Drosophila leads to a new and consistent interpretation of these parts.

In the Bar-eyed mutant of Drosophila melanogaster Meig. a reduction has taken place in the facetted area of the compound eye. The ocular sclerite, however, has not been reduced in size as shown by the orbital and oral bristles. Furthermore, the eye

* Contribution from the Department of Zoology, University of Georgia, No. 6.

presents a cephalic and caudal half which is particularly distinct in the heterozygous female. In Ultra-bar, the region lacking facets encloses the facetted region, (Fig. 5).

The "occipital suture" in Anisolabis maritima passes from the base of the mandible on the ventral side of the head to the ocular sclerite, (Figs. 6, 7 and 8), which it approximates for a considerable distance and then passes caudad to the posterior aspect of the head, then dorsally and becomes obsolete after appearing on the dorsal aspect, (Fig. 7). However, a faint parademe, which is conspicuously marked with the same series of small bristles as the margins of the suture itself, continues forward to the ocular sclerite on the dorsal aspect of the head, thus setting off an unidentified sclerite from the vertex.

From the foregoing facts, this region may be interpreted as the unfacetted portion of a protocular sclerite. This region may be caudad as in Anisolabis (Fig. 8), cephalad and laterad as in Melanopus, (Figs. 11 and 12), or enclosing as in Mantis, (Figs. 9, 10 and 15). The genæ and the lateral portion of the vertex then become the unfacetted portion of the sclerite bearing the compound eye, and may thus be continuous. The protocular sclerite is considered to be bounded cephalad by the mandibulare or trochantin, dorsad by the frontogenal suture to its contact with the compound eye and also by the "occipital apodeme;" caudad and ventrad by the "occipital suture."

There is evidence of a postgenel sclerite as distinct from the vertex by the presence of a transverse suture in Melanopus (Fig. 11) and a parademe in Mantis (Fig. 10). In Pamphilius (Fig. 14) the "occipital suture" touches on the foramen magnum as it passes dorsad, making the homologies clear in Mantis. The "occipital suture" becomes obsolete in some forms by fusion with the epicranial stem to set off the occipitalia. (Tettix, Orchelimum).

Several of the Neuroptera present conditions that can be interpreted on the basis of the foregoing hypothesis. Ululodes (Fig. 17), Olearces, Cauliodes, Conwenzia, (Fig. 16). Even the postorbital crests of Corydalis could readily be considered the caudal portion of the "occipital suture."

The situation in the Trichoptera appears to be as follows: The main laterad suture is the ventral margin of the protocular sclerite. It joins the occipital foramen on its dorsal margin, cutting off the occipitalia as shown by the occipital-postgenal

apodeme in Leptocerid I (Cold Spring Harbor), (Fig. 2). The dorsal arm of the protocular suture is obsolete except in Leptocerid 11561 (Ill., St. Lab.), (Fig. 1), where it appears to be an outgrowth of the epicranial arms near their origin. The cephalic end of the ventral arm of the protocular suture is obsolete, since it follows the ocellar tubercle dorsally, passes between the latter and the antennæ, to meet the epicranial arms.

While it is realized that the perfection of these homologies will be dependent upon the study of further forms, the interpretation brings together facts from the Orthoptera, Euplexoptera, Trichoptera, Neuroptera and Hymenoptera with a possibility of establishing a more consistent phylogeny than that which now exists.

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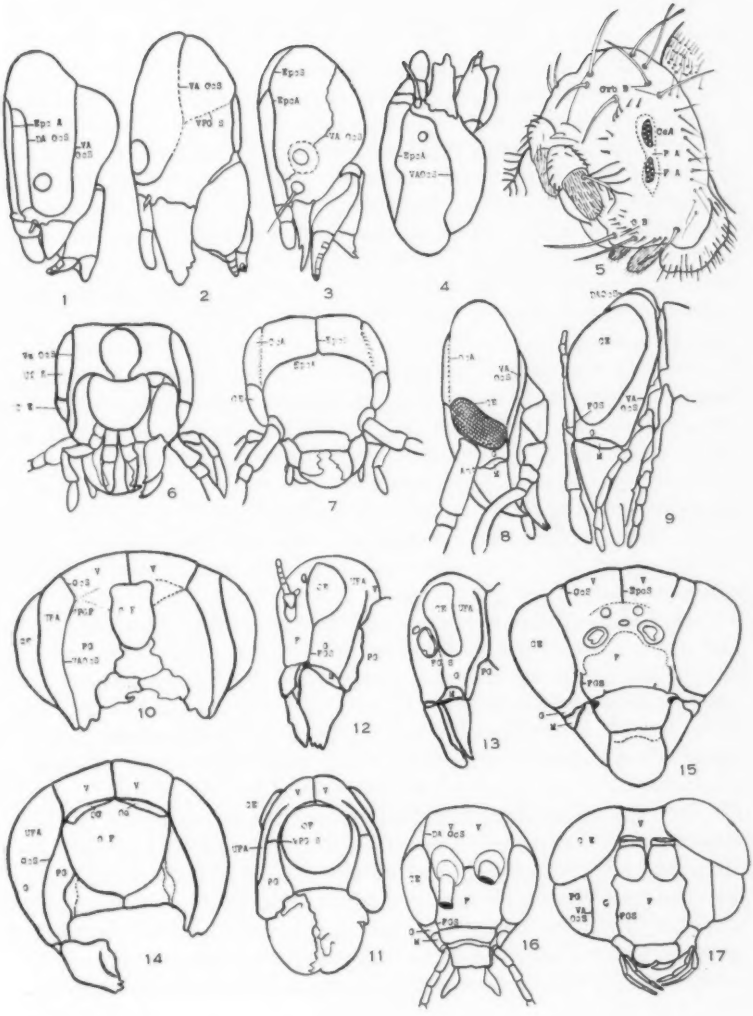
EXPLANATION OF PLATE XXII.

Fig. 1. Leptocerid 11561 (Ill. St. Lab.) Lateral aspect of head.
Fig. 2. Leptocerid I. (Cold Spring Harbor). Lateral aspect of head.
Fig. 3. Leptocerid II. (Cold Spring Harbor). Lateral aspect of head.
Fig. 4. Leptocella uwarowii. Lateral aspect of head.
Fig. 5. Ultra-bar mutant, Drosophila melanogaster. Redrawn from Zeleny.
Fig. 6. Anisolabis maritima. Ventral aspect of head.
Fig. 7. Anisolabis maritima. Dorsal aspect of head.
Fig. 8. Anisolabis maritima. Lateral aspect of head.
Fig. 9. Mantis religiosa. Lateral aspect of head. Redrawn from Yuasa.
Fig. 10. Mantis religiosa. Ventral aspect of head. Redrawn from Yuasa.
Fig. 11. Melanoplus differentialis. Ventral aspect of head. Redrawn from Yuasa.
Fig. 12. Melanoplus differentialis. Lateral aspect of head. From Yuasa.
Fig. 13. Blatta orientalis. Lateral aspect of head. From Yuasa.
Fig. 14. Pamphilius dentatus. Ventral aspect of head. Redrawn from MacGillivray.
Fig. 15. Mantis religiosa. Dorsal aspect of head. From Yuasa.
Fig. 16. Conwenzia hageni. Dorsal aspect of head. Redrawn from Crampton.
Fig. 17. Uluodes. Dorsal aspect of head. Redrawn from Crampton.

LIST OF ABBREVIATIONS.

Ant.....Antenna
C. E.....Compound Eye
DAOcS...Dorsal Arm of Protocular suture
EpcA.....Epicranial Arms
EpcS.....Epicranial stem
F.....Front
F A.....Facetted area
FGS.....Fronto-genal Suture
G.....Genea
M.....Mandibularian
Oc.....Occiput
OcS.....“Occipital suture”
OcA.....Ocular area
OB.....Oral bristles
OrbB.....Orbital bristles
OF.....Occipital foramen
PA.....Pigmented area
Pg.....Post-genea
U. F. A...Unfacetted area
VAOcS...Ventral arm of Protocular sclerite
V.....Vertex
VPGS....Vertex-postgeneal suture
VPGP....Vertex-postgeneal parademe.



Joseph Krafka, Jr.

THE OCCIPITAL SUTURE AND ITS RELATION TO A PROTOCULAR SCLERITE.*

LOUISE ABNEY,
University of Georgia, Athens.

Krafka, in his paper,"The So-called Occipital Suture in the Trichopterous Larvæ and in other Orders", has interpreted a region around the compound eye as the unfacetted portion of a protocular sclerite. This sclerite is considered to be bounded cephalad by the mandibularia or trochantin; dorsad by the fronto-genal suture to its contact with the compound eye and also by the occipital apodeme; cauda and ventrad by the "occipital suture".

In Anisomorpha ferruginia (Gray), the occipital suture passes on the ventral side of the head from the trochantin to the occipital foramen which it follows for a short distance; then it appears on the dorsal surface and is clearly seen for about one fourth of the distance to the compound eye; It is only dimly seen for the other three fourths. (Figs. 1, 2 and 3). The protocular sclerite is bounded cephalad by the trochantin and by the suture going from it to the antennal ring which touches on the compound eye.

In Ceuthophilus uhleri (Scudder), the cephalic boundary of the protocular sclerite is the trochantin; the dorsal boundry is the fronto-genal suture which goes from the trochantin to the antennal ring which in turn touches the compound eye (Fig.4). The ventral and caudal boundary is the occipital suture which passes from the trochantin caudad and then dorsad to the compound eye.

In Nemobius fascitus (DeGeer), there is evidence of the existence of a protocular sclerite, but its boundries are not as definite as in the fore-going examples. It is bounded cephalad by the trochantin, dorsad by the fronto-genal suture to its contact with the compound eye, and ventrad by the occipital suture which joins the epicranial stem. There are two deep wrinkles (W) which seem to indicate the caudal boundary. (Figs. 5, 6 and 7)

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* Contribution from the Zoological Laboratory of the University of Georgia, No. 7.

The genus of a Mantid studied in this connection is still undetermined. It has a greenish-yellow abdomen and an amber colored thorax notched on the lateral edges; the legs are also amber colored. Its measurements are: Length of body 87 mm.; of antenna 30 mm.; of pronotum 9 mm.; of mesonotum 24 mm.; of wing 7 mm.; of fore-leg: femur 15 mm., tibia 18 mm., tarsus (5 jointed) 17 mm. The greatest width of the thorax is 3 mm. and of abdomen is 5 mm. The tibia has two big central spines from which go two rows of spines to the junction with the tarsus; one row has six medium-sized spines and one has seventeen tiny ones. The first joint of the tarsus has two rows of small spines ending in one large spine. The last joint has two small claws.

On this Mantid, the trochantin bounds the protocular sclerite cephalad, and the fronto-genal suture bounds it dorsad. The occipital suture passes on the ventral surface dorsad until it reaches the caudal portion of the head; then it turns and goes to the occipital foramen. (Figs. 8, 9 and 10) There is a branch of the occipital suture (DAOcS) on the dorsal surface which goes toward the antennal ring but stops a short distance from it. However, a suture extends from the antenna in the direction of this first suture, so there is only a very small space where no suture is seen.

The occipital suture of Myrmeleon (Neuroptera) is very much like that of the Mantid (Orthoptera). It too has a ventral arm going to the base of the mandible, and a dorsal arm going toward the antennal ring, though it does not reach it. Here also as in Mantid, the fronto-genal suture goes from the trochantin to the antennal ring. (Figs. 11, 12 and 13).

The protocular sclerite is not so well-defined in Corydalis, but it can be determined if the post-orbital crest be considered the caudal portion of the occipital suture. Figs. (14, 15 and 16).

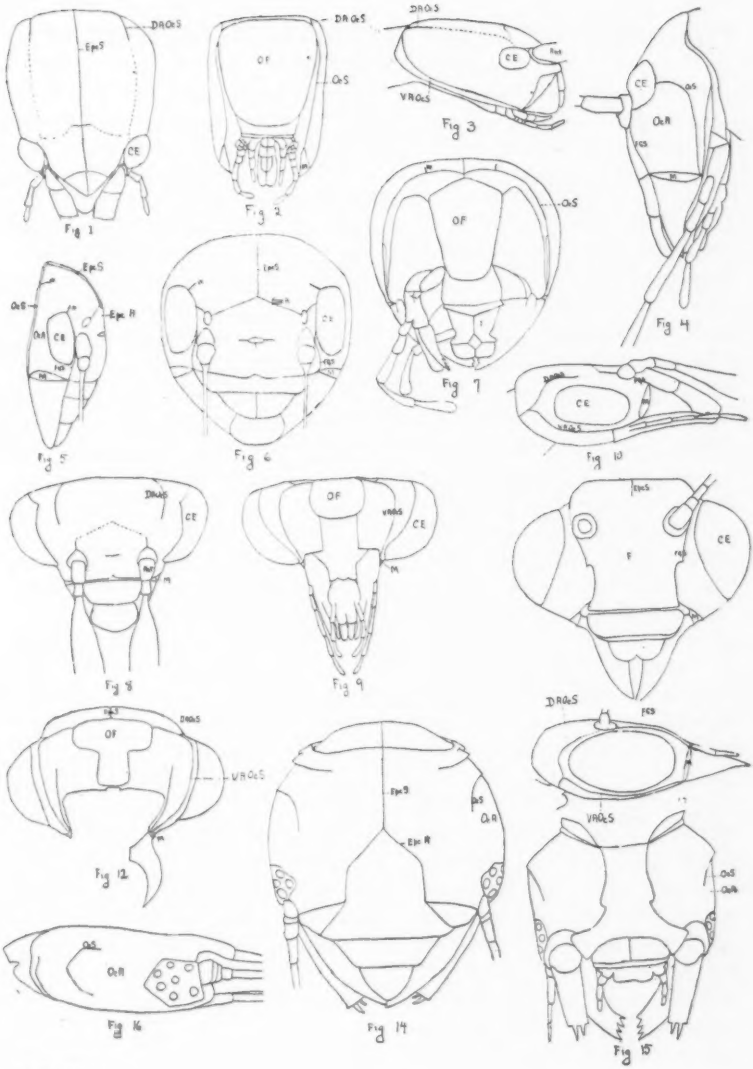
All of these heads were studied in an effort either to prove or to disprove Krafka's theory, following a study of some of the heads discussed by him—Anisolabis maritima, Mantis religiosa, Leptocerid 1 (Cold Spring Harbor) and Melanoplus differentialis. The results thus far obtained seem to bear out his theory of the existence of a protocular sclerite.

EXPLANATION OF PLATE XXIV.

Fig. 1. Anisomorpha ferruginia—Dorsal aspect of head.
Fig. 2. Anisomorpha ferruginia—Ventral aspect of head.
Fig. 3. Anisomorpha ferruginia—Lateral aspect of head.
Fig. 4. Ceuthophilus uhleri—Lateral aspect of head.
Fig. 5. Nemobius fasciatus—Dorsal aspect of head.
Fig. 6. Nemobius fasciatus—Ventral aspect of head.
Fig. 7. Nemobius fasciatus—Lateral aspect of head.
Fig. 8. Mantid?—Dorsal aspect of head.
Fig. 9. Mantid?—Ventral aspect of head.
Fig. 10. Mantid?—Lateral aspect of head.
Fig. 11. Myrmeleon—Dorsal aspect of head.
Fig. 12. Myrmeleon—Ventral aspect of head.
Fig. 13. Myrmeleon—Lateral aspect of head.
Fig. 14. Corydalis—Dorsal aspect of head.
Fig. 15. Corydalis—Ventral aspect of head.
Fig. 16. Corydalis—Lateral aspect of head.

ABBREVIATIONS.

Ant.....Antenna
CE.....Compound eye
DAOcS...Dorsal arm of occipital suture
EpcA.....Epicranial arm
EpcS.....Epicranial stem
F.....Front
FGS.....Fronto-genal suture
M.....Mandibularia (Trochantin)
OcS.....Occipital suture
OcA.....Ocular area
OF.....Occipital foramen
VAOcS...Ventral arm of occipital suture.



Louise Abney.

THE ORIGIN OF MIXED BROODS IN POLYEMBRYONIC HYMENOPTERA.

R. W. Leiby,
State Department of Agriculture, Raleigh, N. C.

The opinion prevails generally among students of the polyembryonic Hymenoptera that an egg deposited by a fertilized female gives rise to a pure female brood of parasites, that one deposited by an unfertilized female develops a male brood, and that a mixed brood (male and female) is produced from eggs deposited by a fertilized and unfertilized female when they both happen to oviposit in the same egg. Among those who have advanced evidence in support of this general theory are Bugnion '92 and Marchal '04, in *Ageniaspis fuscicollis;* Silvestri '06, in *Litomastix truncatellum;* Leiby '22, in *Copidosoma gelechiæ;* and Leiby and Hill '23 and '24, in *Platygaster hiemalis* and *P. vernalis.*

Patterson, '19, is inclined to believe that both male and female individuals can and do develop from a single fertilized egg, and that males only are produced from unfertilized eggs. He is of the opinion that the males in a mixed brood may be accounted for on a monozygotic basis by the Bridges method of somatic non-disjunction of the sex chromosomes in an originally fertilized egg; in which as the cleavage nucleus divides, certain of the blastomeres (cleavage or embryonic nuclei) would receive only a single x-chromosome, and each blastomere so affected becomes thereupon the progenitor of one or more male embryos. The number of male embryos would depend upon the time during cleavage that the abnormal behavior of the sex chromosomes took place. If for example the behavior were abnormal at the first division, the resultant brood would be composed of male and female adults in more or less equal numbers. If the abnormal behavior of the sex chromosomes occurred relatively late in the division period of the blastomeres, the brood of adults developed therefrom would be preponderantly female with only a few male adults. This theory, Patterson believes, will account for the development of most or many of the mixed broods found in nature of *Copidosoma*

gelechiæ, *Paracopidosomopsis floridanus* and *Platygaster felti*, the sex ratio of which he lists in some detail in the paper referred to.

No cytological evidence in support of the Patterson theory has as yet been presented. It appears on the contrary, that there are now sufficient data and observations available to substantiate the earlier belief that mixed broods are of dizygotic origin; that females are produced from fertilized eggs, and that males are the product of unfertilized eggs.

The sex ratio of three species of polyembryonic parasitic insects has received considerable attention by the writer in his study of their development. Notes on the number and sex of the adult parasites have been secured by rearing them from hosts collected in the field, by the breeding of the adults from eggs deposited by the parent parasites under laboratory controlled conditions, and by microscopic examinations of eggs of the parasites after they have been deposited within the host eggs. The species studied are *Copidosoma gelechiæ*, *C. truncatellum* and *Platygaster variabilis*. In addition, the writer in cooperation with C. C. Hill has studied the development and sex ratio of *Platygaster hiemalis* and *P. vernalis*, which differ quite markedly in their sex ratio and in their manner of development. The sex ratios of the species studied will be presented separately.

Copidosoma gelechiæ.

Copidosoma gelechiæ is a parasite of the goldenrod gall maker *Gnorimoschema gallæ-solidaginis*, an average of 174 individuals maturing in a host larva from a single egg which was deposited in the egg of the host. The sex ratio of the parasites of 420 broods, totaling 73,080 individuals, has been ascertained at odd times during the past ten years. Of the 420 broods, 261 or about 62 percent were pure female broods, 155 or about 37 percent were pure male broods, and 5 broods or about one percent yielded both males and females. Of the five mixed broods, two yielded males and females in more or less equal numbers; while three broods were largely female with a few males, the smallest number of males in a brood being 29, which were reared along with 178 females.

Patterson, '19, records the sex ratio of 162 broods of this species, of which 55 percent are pure female, 38 percent are male, and 10 broods or 6 percent are mixed.

It has been previously pointed out by the writer ('22) that *C. gelechiæ* deposits a single egg at each insertion of the ovipositor in the host egg. Rearing records of this parasite from egg to adult stages under controlled conditions have also shown that both males and females are developed from eggs deposited by females that had been observed to have copulated with males, but the broods in all instances (nine reared in 1916-1917, and four reared in 1917-1918) were either pure male or pure female broods. From eggs deposited by virgin females, six broods yielding males only were reared in 1917, and four broods yielding only males were reared in 1918. In conducting these experiments, virgin females were removed from their pupation chambers separately while the parasites of a brood were emerging. Males were introduced into a vial containing segregated virgin females when it was desired to fertilize the females. The parasites used were permitted to oviposit only once in each host egg.

The results first indicated that either a pure male or a pure female brood was developed from inseminated eggs since they were deposited by females that had been seen to copulate with males. Microscopic examinations of eggs show upon further study, however, that the sperm is sometimes absent in an egg deposited by a fertilized female. Thus if two eggs are deposited by the same fertilized female in a host egg at two separate insertions of the ovipositor, as has been observed to take place at times, there could be expected to develop therefrom a brood of parasites which would include both the male and female sexes. Under natural conditions two eggs of *C. gelechiæ* are rarely found in a host egg. Likewise two separate polygerms or polyembryonal masses (each originating from a parasite egg) are rarely found in a single young host larva. The chances of finding two polygerms rather than one in host larvæ are approximately the same as those of rearing a mixed brood of parasites rather than a pure male or a pure female brood. It is worthy of note also that the individuals of a mixed brood are likely to outnumber those of either a pure male or a pure female brood, indicating further that a mixed brood originates from two parasite eggs.

Copidosoma truncatellum.

Copidosoma truncatellum is a parasite of the cabbage looper *Autographa brassicæ*, an average of about 1526 individuals issuing from a host larva. The writer's experience in rearing broods of the parasites from field collected material has been limited to nine broods, the sex ratio of which is given below.

Number of Individuals in a Brood	Percentage of Females	Percentage of Males
1634	100.0	0.0
1141	97.6	2.4
2041	95.5	4.5
1825	82.4	17.6
1724	80.2	19.8
1538	77.2	22.8
1481	66.4	33.6
1778	64.5	35.5
1869	35.8	65.2
Average 1670	77.6	22.4

More extensive data on this species have been issued by Patterson, '19, in which he finds that of 177 broods, 1.7 percent are pure female broods, 11.3 percent are pure male broods, and 154 or 87 percent are mixed broods.

Limited experiments conducted by the writer indicate that eggs deposited by virgin females give rise exclusively to males. Thus from a number of eggs oviposited in by virgin females on September 4, 1917, four pure male broods were reared on November 5, 1917, which yielded 1324, 1463, 1572 and 1681 males respectively. Unfortunately no broods were reared to maturity from eggs deposited by fertilized females, the host larvæ being prepared as needed for later microscopic study of the development of the parasites.

A study has been made, however, of the position of the parasite's eggs in the host eggs and whether or not all eggs deposited by fertilized females contained a sperm. The position of the *truncatellum* eggs in host eggs shows that in 78 instances single eggs were deposited by the parasite at each oviposition (without withdrawing the ovipositor); while in 76 instances or about 49 percent, two eggs were deposited at each insertion of the ovipositor. Examination of the eggs prior to cleavage shows further that the second of a pair of eggs deposited at the same time by a fertilized female is without a sperm or male nucleus in approximately 80 percent of the instances; the

actual percentage being difficult to ascertain, because failure to locate a sperm in a sectioned egg for various reasons is not absolute proof of its absence. Moreover, it has been observed that the sperm is absent in some eggs deposited singly in host eggs by fertilized females though such instances are rare. This fact has been observed in a small number of eggs that happened to be deposited singly by the same fertilized female in different host eggs.

Laboratory studies also show that the female parasites are not reluctant to oviposit in a host egg that has been previously attacked by one or more other females. Indeed it is not difficult to have as many as fifty parasite eggs placed in a single host egg. This has been done under experimental conditions a number of times so that the early development of the eggs could be studied. Frequent ovipositions by various females in host eggs do not probably occur under natural conditions, but the female of *truncatellum* has a decided tendency to fail to recognize the fact that a host egg has been previously oviposited in by another female, which is not generally the case in other species of polyembryonic hymenoptera studied by the writer.

Platygaster hiemalis.

Platygaster hiemalis is a parasite of the Hessian fly which has been shown by Leiby and Hill, '23, to develop both monembryonically and polyembryonically, two individuals arising from a single egg when the latter method of development is followed. From four to seven eggs are deposited in a host egg in a cluster at each oviposition by the female parasite. Under natural conditions a female parasite will insert its ovipositor only once in a host egg. Furthermore a host egg when once oviposited in by a female parasite is not likely to be oviposited in by another female parasite. An average of 6.31 individuals issue from a single host carcass.

The rearings of 100 parasitized puparia (made by C. C. Hill) show 20 pure female broods and no pure male broods. Of the 80 mixed broods, 23 contained a single male, 25 contained 2 males, 12 contained 3 males, and 20 contained four or more males. In 71 of the 100 puparia the females exceeded the males in number, in 24 the males exceeded the females, while in the other five host puparia the males and females were reared in equal numbers.

Platygaster vernalis.

Platygaster vernalis is another polyembryonic parasite of the Hessian fly. As has been shown by Leiby and Hill, '24, the eggs are deposited in the eggs of the host, the pre-larval development taking place exclusively in the mid-intestine of the host larva. An average of 7.91 individuals emerge from a single host. The female parasite oviposits but once as a rule in a host egg and deposits but a single egg at each oviposition. Occasionally two or even three eggs are observed in the mid-intestine of a host.

The sex ratio of this species as recorded by Hill, '23, shows that of 48 host puparia collected in the field, 40 yielded either pure male or pure female broods of parasites, while each of the remaining 8 puparia produced both male and female parasites.

Some data on the sex ratio of a closely related if not identical species, *Polygnotus minutus*, which also develops by polyembryony in the mid-intestine of the Hessian fly in France, has been presented by Marchal, '04. Of 16 broods he found that eight were pure female, six were male, and two were mixed. In the case of the two mixed broods there were three females and three males, and three females and one male, respectively.

Platygaster variabilis.

Platygaster variabilis is a polyembryonic parasite of the gall midge *Rhopalomyia carolina*, maker of a rosette gall on the terminal stem of goldenrod. An average of 15 individuals emerge in the early fall from each parasitized larva.

The sex ratio of 217 broods has been determined during the years 1922 and 1923. Of the 217 broods, one was a pure male brood, 17 were pure female broods, and 199 or nearly 92 percent were mixed broods.

It has been determined by the writer that *P. variabilis* deposits from three to six eggs at one insertion of the ovipositor in the host egg, just as *P. hiemalis* does. Also, females that have been fertilized have a tendency to deposit one or two eggs in the cluster of five to eight, that do not contain a sperm, at least a microscopic examination of some of the eggs indicates the absence of the sperm in them.

The accompanying table presents the data of the sex ratio of 209 of the 217 broods. Broods 210 to 217 are mixed broods that contained from six to twelve males each in which there is no

brood containing 7 males, 1 brood containing 8 males, 1 containing 9 males, and two containing 12 males. The number of broods encountered that contain from 7 to 12 males each is too small to furnish a reliable average of the data that is desired.

A study of the table indicates that as the number of males in a mixed brood increases, the number of females in the broods also increases accordingly. It also shows that the proportion of males to females reared in a brood decreases as the total number of both sexes reared from a brood increases.

Number of Broods Containing		Total number Females in Brood	Average Number Parasites per Brood	Average Number Females per Brood	Proportion of Males to Females
No Males	17	102	6.00	6.00	
One Male	63	625	10.92	9.92	1 to each 9.92
Two Males	71	925	14.97	12.97	1 to each 6.49
Three Males	31	566	21.26	18.26	1 to each 6.08
Four Males	13	237	22.23	18.23	1 to each 4.56
Five Males	11	234	26.27	21.27	1 to each 4.25
Six Males	3	57	25.00	19.00	1 to each 3.17

SUMMARY AND DISCUSSION

In *Copidosoma gelechiae* snd *Platygaster vernalis*, only a small percentage of the broods are represented by both sexes. Both species likewise deposit as a rule only a single egg in the host egg at each insertion of the ovipositor. Furthermore it is rare that the egg will be attacked by two different females under natural conditions. The writer believes that the occurrence of mixed broods in these two species is thus readily accounted for by the two egg hypothesis.

In *Copidosoma truncatellum* most of the broods are mixed. In this species in approximately half of the ovipositions (and

perhaps more) the female deposits two eggs at a time. The second egg of a pair deposited by a fecundated female is without a sperm in at least 80 percent of the instances. More than one parasite will oviposit in a host egg under natural conditions.

Reference to Patterson's data on the sex ratio of this species shows that in 2 cases out of 60 there was but one male reared in each of two mixed broods that contained 912 and 1550 individuals respectively. In a few other mixed broods the number of males is small in proportion to the females. In the opinion of the writer the occurrence of a single male in a mixed brood is due to a monembryonic development of the second of two eggs deposited by a fertilized female that did not contain a sperm. If this condition prevails, as has been shown for *P. hiemalis*, it is also not unlikely that an unfertilized egg may be inhibited in the complete cleavage of its embryonic nuclei to the end that only a small number of males originate from such an egg, whereas a larger number would be developed from the fertile egg even though it were deposited by the same female along with the unfertilized egg. Just what conditions govern the production of the proportionate number of males and females in a mixed brood of *C. truncatellum* is as yet largely a matter of conjecture. The great number of individuals (1000 to 2500) reared from a single host, and the fact that the species is the most specialized of the polyembryonic hymenopters yet studied, make conclusions on the origin of the mixed broods appear perplexing. Factors which must be considered and of which little is definitely known are,—the origin of the so-called asexual larvæ, the subdivision of the ploygerm into smaller secondary and tertiary masses that become distributed in the body of the host, and the failure of some of the smaller groups of germs to mature parasites because they do not become properly invested with host tissues or with sufficient trophamniotic membrane so that they can continue their development.

On the basis of what is believed to be the origin of mixed broods in other polyembryonic hymenopters as presented in this paper, and on unpublished studies of the development of the species made by the writer, the opinion is ventured here that mixed broods of *C. truncatellum* are of dizygotic orgin.

In *P. hiemalis* and *P. variabilis* and probably in *P. felti* the writer believes that mixed broods are of dizygotic orgin. The

occurrence of males in mixed broods is due it is believed to the habit of a fertilized female in depositing a cluster of three to seven eggs, one or two of which do not become inseminated during the act of oviposition, while the remainder of a cluster do become inseminated. There is some evidence based on a count of chromosomes to indicate also that the inseminated eggs twin or develop polyembryonically almost regularly, though occasionally one egg may develop a single female while its twin component becomes aborted. The eggs that lack a sperm have a tenency to develop monembryonically with an occasional one twining.

A study of the factors responsible for the origin of mixed broods in the polyembryonic hymenopters has revealed the striking fact that insemination of an egg by a fertilized female may apparently be controlled. It is certain that not every egg deposited by a fertilized female contains a sperm; though it was deposited by a female known to have been fertilized, and though it was deposited along with eggs that do contain a sperm. The belief has been previously expressed (Leiby and Hill '23) that in the case of *P. hiemalis*, the female does not control "insemination as the honeybee apparently does, but the short period of time required by the parasite to deposit a group of eggs indicates the probability of the eggs passing the spermatheca duct so rapidly during oviposition that all of the eggs do not receive a sperm."

In view of further studies the writer now believes it safe to conclude, that insemination or lack of it by fertilized females, is controlled in the polyembryonic hymenopters this far studied. Since only males are produced from unfertilized eggs, and since the species can obviously be continued only by the production of females, the control of insemination would be, and is, of advantage to the adult parasites of a brood. It should be remembered that the adult parasites are very minute; that as far as is known each species is limited in its development to a definite host species; that the chance of a minute insect finding its proper host egg by means of contact with its antennae are exceedingly remote; and that the production of males along with females (mixed broods) would be advantageous to the end, that females would have greater chances of becoming fertilized when males co-developed and issued in the same host along with

the females. Control of insemination by the fertilized female parasite would therefore be a decided advantage in the perpetuation of the species.

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LIFE HISTORY STUDIES OF SEVEN DESCRIBED SPECIES OF THE GENUS LACHNUS.*

By M. A. Palmer.

The following species have been more or less incompletely described and most of them have not been illustrated fully, if at all. Much work has been done by the author on each of these species in the way of rearing the different forms in the insectary. Five species have been reared from the egg, through successive generations to the summer forms. Sexual forms of all, except *pseudotsugæ*, have been reared from summer forms captured in nature and cared for in the insectary. In practically every case the forms have been checked up by comparison with specimens taken in nature, and never has any noticeable difference been detected aside from size, and that in only a few cases.

Technic: These forms were reared on branches of conifers kept fresh in water for a number of weeks in the insectary. When the branches failed the aphids were transferred to fresh ones. A tree on the campus was also used, and on it one species was kept going for more than a year.

For assistance in collections taken out of doors, which corroborated reared specimens and also furnished material for many of the drawings, the writer is indebted to L. C. Bragg, C. P. Gillette, F. C. Hottes, C. A. Bjurman, J. L. Hoerner, and E. Bethel. Mr. F. C. Hottes also deserves special mention for a large amount of assistance rendered in rearing and many valuable suggestions for devices and apparatus to be used in the work. Acknowledgments are also, most of all, due to Dr. C. P. Gillette, under whose direction the work was undertaken and whose encouragement and aid made its accomplishment possible.

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*Done as part requirement for the degree of Master of Science in the Department of Entomology, at the Colorado Agricultural College, and in connection with an Experiment Station project dealing with with habits and Life Histories of the Aphididae. Also see article "Histories of new species of the genus *Lachnus*," published in Annals of the Entomological Society of America, Vol. XVII, No. 1 (1924).

Lachnus pseudotsugæ Wilson.

Lachnus pseudotsugæ Wilson. 1912, Can. Ent., vol. 44, p. 191, 302, (Orig. desc.). 1919, Swain, Univ. of Calif. Tech. Bull. Ent., vol. 3, p. 48, (record).

Egg (Not illustrated). Taken on needles of *Pseudotsuga taxifolia* (Poir.) Britt., in Estes Park, Colo., April 12, 1922. Found on dorsal side of needles, in rows of two or three, laid end to end, hatching with open end toward tip of needle. Color black, with very little powdery covering.

Fundatrix, or *Stem Mother*. Young, newly hatched: From eggs above mentioned.

Color: dull yellowish brown shading to dusky on dorsum of abdomen, head shining black, legs light brown, two dorso-lateral shining black spots on prothorax.

2nd instar: Above mentioned examples, feeding on bark of twig.

Color: pale cinnamon brown, shading into yellowish brown on head and prothorax, a pair of dark splashes on metathorax; legs and antennæ pale yellowish thruout; entire dorsum of thorax and abdomen covered with slight pulverulence.

Adult (Plate XXIV, Fig. 1). Described from one specimen taken on bark of twigs of *Pseudotsuga taxifolia*, in Estes Park, Colorado, July 1, 1915,[1] two specimens taken in hills near Bellevue,[2] Colorado, June 3, 1922, and four specimens taken in Estes Park,[2] Colorado, June 27, 1924. Examples were all quite old.

Color: Same as apterous summer viviparae except darker and without powder, which latter had probably been rubbed off.

Measurements: Body, 3 – 3.5 mm., robust; hind tibia, 1.9 mm. Other measurements as in apterous summer viviparæ.

Apterous Summer Viviparous Female: Described from four specimens taken on bark of twigs of *Pseudotsuga taxifolia*, July 2–12, 1915, reared from first collection of fundatrices above-mentioned, and eleven specimens taken June 16–20, 1922, reared from second collection above-mentioned.

Young, 1st instar (Plate XXIV, Fig. 2).

Color: yellowish brown throughout, lighter on medio-dorsum, with darker patch on middle of abdomen. Head and prothorax darker to dusky brown lightly covered with white powder, which is heavier on margins of first two thoracic segments and median prothorax; legs and antennæ as in adult.

Later instars (Plate XXIV, Fig. 3.)

Color: pale yellowish tinged with greenish on posterior half of abdomen; abdomen with two longitudinal green stripes on dorso-lateral portion, head and first two thoracic segments brown; dorsum marked with white secretion on intersegmental lines, median portion of thorax, and lateral patches covering entire width of segment on three thoracic and third and fifth abdominal segments; antennæ pale excepting tips, legs pale with usual dusky markings. Just before becoming adult color is often rather a dirty white with only slight brownish markings.

[1]Altitude, 8,000 feet.
[2]Altitude, 6,000 feet.

Adult (Plate XXIV, Fig. 4, and Plate XXV, Figs. 1, 2, and 4.)

Color: pale brownish shading to whitish on medio-dorsum of first four segments of abdomen, a pair of dusky areas on dorsum of each thoracic and first abdominal segments; head and prothorax medium brown, slight dusky dashes on segments two, three, and five, in some individuals; slight traces of powder on lateral portions of meso- and metathorax and the fourth abdominal segment, and on all intersegmental lines; antennæ pale brownish yellow with tips of joints and entire terminal joint dusky; legs pale brownish yellow with entire tarsi, tips of first two pairs of tibiæ, and one third to one half hind tibiæ knees and distal two thirds of hind femora dusky to black; cornicles black but showing as little more than mere rims, chitinized area sometimes present but hardly elevated and visible only in cleared specimens. Red coloration in balsam, mentioned by Wilson hardly noticeable in our balsam mounts, but very slight traces observed in alate mounts in gum arabic and glycerine medium.

Measurements; body rather robust, 3 mm. in length, 2 mm. in width, hind tibia, 2 mm. antenna, 1.1 mm.; joints of antenna as follows: I., .10 mm.; II, .10 mm.; III, .37–.42 mm.; IV, .15–.18 mm.; V, .18–.20 mm.; VI, .12 + .04 mm; no secondary sensoria evident; unguis conical. Hairs on hind tibia rather stout, set at an angle of 45 degrees, .07–.08 mm in length, hardly equalling diameter of tibia, moderately numerous; hairs on antenna similar to those on tibia, .05 mm in length, exceeding diameter of joint; hairs on body stout, rather sparse, and .04 mm in length. Beak short, attaining no farther than second coxæ, terminal joints .15, .15, and .05 mm respectively, rather robust in appearance.

Sexuparæ observed in Estes Park, Colorado, Sept. 1, 1924, were distinctly reddish in color and with pronounced blackish cross bands, and presented a much more striking appearance than the summer viviparæ.

Alate Summer Viviparous Female; (Plate XXIV, Fig. 5, Plate XXV, Figs. 3, 5, and 6.) Described from a single specimen reared along with above apteræ from fundatrices of second collection mentioned above, maturing June 20, 1922, and from twelve specimens taken in nature as full grown pupæ, progeny of fundatrices of the same date, matured June 27, 1924, on twigs of *Pseudotsuga taxifolia* near Estes Park, Colorado.

Color: abdomen yellow brown, fading to whitish on median portions of first and second abdominal segments, sometimes tinged with greenish in two dorso-lateral stripes, head and thorax brown to dusky brown; cornicles appearing as mere rims, very slightly raised; slight powdery markings on intersegmental lines on dorso-median portion of abdomen, and grooves in thorax; antennæ and legs as in apteræ.

Measurements: body, 3 mm. long, hind tibia, 2 mm., antenna, 1 mm.; joints of antenna as follows: I, .08 mm.; II, .08 mm.; III, .35–.42 mm.; IV, .18 mm.; V, .18–.21 mm.; VI, .12 mm. + .04 mm.; secondary sensoria as follows: III, 2–7; IV, 1–2; V, 0; unguis conical. Beak attaining first segment of abdomen. Hairs on middle of hind tibia spine-like, set at an angle of about 60 degrees, .10–.12 mm. in length, equalling

diameter of tibia, rather numerous; hairs on antenna of same character. .05 mm. long, exceeding diameter of joint, moderately numerous; hairs on body finer, .05 mm. in length. Wings hyaline except subcostal area, which is dusky brownish, stigma brownish, media twice branched and faint; hind wing with two cross veins.

Male (Plate XXIV, Fig. 7, and Plate XXV, Fig. 7). Described from five specimens reared from pupæ taken on twigs of *Pseudotsuga taxifolia* in Estes Park, Colorado, Sept. 1, 1924.

Pupæ pale green on dorsum of abdomen with a pair of darker green longitudinal rows of spots; head and thorax slightly dusky.

Adult: Color, pale sordid green on dorsum of abdomen, with two longitudinal rows of dusky green spots; head dusky brown to blackish thorax the same; entire dorsum lightly covered with powder. Antennæ, legs and wings as in viviparæ.

Measurements: body slender, 2.5 mm. in length, .75 mm. in width; hind tibia 1.6 mm.; antenna 1.2 mm.; joints of antenna as follows: I, .06 mm.; II, .08 mm.; III, .40–.50 mm.; IV, .18–.21 mm.; V, .13+ .04 mm.; secondary sensoria as follows: III, 26–36; IV, 6–15; V, 5–11; unguis rather long conical. Hairs on middle of hind tibia same texture and length as alate viviparæ, but equalling two to three times diameter of tibia. All other characters as in alate viviparæ.

Oviparous Female (Plate XXIV, Fig. 6 and Plate XXV, Fig. 8). Described from eight specimens taken near Glenn Haven,[1] Colorado, Sept. 27, 1924, on twigs of *Pseudotsuga taxifolia.*

Color: light brown with slight reddish tinge, especially on abdomen; a pair of areas on second and third thoracic, first to third and eighth abdominal segments and faint line between cornicles dusky to blackish; white markings as follows: lateral and median portions of intersegmental lines conspicuous, lateral areas of abdominal segment four and thoracic segments two and three, and entire dorsum of abdominal segments six, seven and eight more or less white.[2] Other characters as in apterous summer viviparæ, except hind tibiæ which are slightly shorter and stouter, about 1.75–1.9 mm. in length and bearing scattered flat, faint sensoria thru-out entire length.

Collections were made as follows, all on bark of twigs of *Pseudotsuga taxifolia* (Poir.) Britt., in Larimer County, Colo.[3] One collection by C. P. Gillette, others by the author.

Fundatrix or Stem Mother: Three collections, from June 3[4] to June 27.[5]
Apterous Summer Viciparous Female: Six collections from June 16[4] and July 6[5] September 1.[5]
Alate Summer Viviparous Female: Two collections taken, June 20 and June 27.[6]
Male: One collection, September 2.[5]
Oviparous Female: Two collections, September 8[5] and 27.[1]

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[1]Altitude, 7,000 feet.
[2]Two specimens reared from young taken in Estes Park September 1, 1924, did not show the white tip to the abdomen. H. F. Wilson does not mention it in his description.
[3]Altitudes, 6,000 to 8,000 feet.
[4]Altitude, 6,000 feet.
[5]Altitude, 8,000 feet.
[6]Altitude, 6,500 feet.

This species is moderately active and seems to have a periodic instinct to wander off. Whole colonies would simultaneously leave the twig just before they were ready to reproduce.

The appearance of alate in the second generation seems to vary. In the case of the fundatrix taken July 1, 1915, neither alate nor pupæ appeared in the progeny of the next generation. In the case of fundatrices taken June 3, 1922, two alate appeared among 25 apterous. In the case of a fundatrix taken June 27, 1922, with a colony of descendants, nearly all the progeny at the time of the capture were full grown pupæ, twelve in number, with no apteræ evident.

In the appearance of the sexuales, the males were observed to appear first, and the mature oviparous females appeared about the time the males disappeared.

This species seems to be rather rare in this part of the state and no heavy infestations have been noted.

Lachnus taxifoliæ Swain.

Lachnus taxifoliæ Swain. 1918, Trans. Am. Ent. Soc., vol. 44, p. 11, 1918, (Orig. desc.). 1919, Swain, Univ. of Cal. Tech Bull. vol. 3, p. 50.

Egg (Plate XXIV, Fig. 15). Described from eggs taken March 31, 1922, on needles of *Pseudotsuga taxifolia* (Poir.) Britt., on campus at Ft. Collins, Colorado. Found on dorsal side of needles, laid end to end, from one to three in a row. Just hatching at this date, with open end of egg toward base of needle. Eggs taken in Estes Park[1], April 20, 1921 were arranged in rows of three to four, also hatching with open end toward base of needle. Color, black covered with light pulverulence.

Fundatrix or *Stem Mother* (Plate XXIV, Fig. 8.) Young described from examples hatched from both collections of eggs described above.

1st instar, newly hatched (Plate XXIV, Fig. 8).

Color: dark olive or rusty brown to black throughout, with legs dark dusky. No powdery secretion apparent. Young four to five days old same color, but covered with even coat of powder on body with head black and naked except a median and two lateral stripes of white.

2nd instar. Color, black to brownish with powder broken into bands and patches.

3rd instar. Color dark brown with patches of powder.

Adult (Plate XXIV, Fig. 9). Described from one specimen taken near Bellevue, Colorado,[2] on same host as above, May 19, 1921, the

[1]Altitude, 8,000 feet.
[2]Altitude, 6,000 feet.

progenitor of the colony from which eggs and young fundatrices above-mentioned were taken, twenty-four specimens reared from young described above.

Color: dark brown to black throughout dorsum, with powdery secretion reduced to mere dashes on median and intersegmental lines, head, most of prothorax, and lateral portions of thoracic and fourth abdominal segments more or less white in young examples; older individuals may show hardly any pulverulence; legs and antennæ as in summer viviparæ. Cornicles black and hardly visible.

Measurements: Body, 2.5 mm.–3 mm. in length, robust, 1.5–2.5 mm. in width; hind tibia, 1.5–2 mm.; antenna, 1 mm.; other characters same as apterous summer viviparous female described below. Legs appear short and stout.

Apterous Summer Viviparous Female:

Young (Plate XXIV, Fig. 12). Described from numerous specimens, born from all of the above mentioned lots of fundatrices.

1st instar. (Plate XXIV, Fig. 12.)

Color: water white tinged with brownish and marked with two longitudinal rows of green spots on dorsum of abdomen; dusky markings as follows; entire head, a pair of areas on prothorax, lateral portions of first, second, third, and eighth abdominal segments, and cornicles; dorsum mottled with white pulverulence especially pronounced on median, intersegmental line, and lateral areas on thoracic segments and head. Antennæ and legs colorless, with knees, tips of antennæ, tarsi, and tibiæ dusky.

Later instars (Plate XXIV, Fig. 13.)

Color: sordid brownish shading to yellowish brown on fifth abdominal segment or on dorsum of entire abdomen, a pair of longitudinal rows of green areas on abdominal segments often coalescing so as to form two irregular longitudinal lines, dusky markings on lateral areas of thoracic and abdominal segments; dorsum marked with pulverulence on median and intersegmental lines, entire head, and dorso-lateral areas of fourth abdominal segment; antennæ and legs as in adult.

Adult (Plate XXIV, Fig. 11 and Plate XXV, Figs. 12, 13, 14, and 15). Described from twenty-two specimens above described as young and ten specimens at Laramie-Poudre Tunnel[1], Colorado, August 12, 1922.

Color: dark brown to blackish shading to yellowish brown on median line, paler on head and thorax; white markings appearing as broken areas on median and intersegmental lines, a large patch on dorso-lateral parts of fourth abdominal segment, one patch covering entire head and prothorax; antennæ pale brownish yellow, dusky on entire first, second and sixth, and tips of third, fourth, and fifth joints; legs pale brownish yellow with tarsi, knees, tips of first two pairs of tibiæ, almost entire hind tibiæ and femora dusky to black; cornicles black; eyes dark reddish brown to black.

[1]Altitude, 8,000 feet.

Measurements: body 3 by 1.5 mm. to 3.5 by 2 mm., robust, hind tibia 2 to 2.5 mm., antenna 1.1 to 1.4 mm.; joints of antenna as follows: I, .08 mm.; II, .09 mm.; III, .40–.50 mm.; IV, .15–.21 mm.; V, .22–.25 mm.; VI, .13+ .04 mm.; secondary sensoria none; unguis conical. Hairs on middle of hind tibia fine, numerous, set at an angle of about 35 degrees, .06 mm. long, less than diameter of tibia; hairs on antenna similar to those on tibia but exceeding diameter of joint; hairs on body .06 mm. in length, fine, upright, and moderately numerous. Cornicles mere rims, .01 mm. in height, without perceptibly raised vase, though a small surrounding area may be darkened. Beak attaining first segment of abdomen, terminal joints rather robust, measuring .19, .16, and .08 mm. respectively.

Alate Summer Viviparous Female (Plate XXIV, Fig. 10 and Plate XXV, Fig. 16.). Described from ten specimens reared on tree on campus, taken during June and July 1921, progeny of fundatrix taken in hills enar Bellevue, May 19, 1921, and one specimen taken in Estes Park,[1] Colorado, July 26, 1922.

Color: amber to dusky brown on abdomen shading to dark brown or black on head and thorax, mottled with pulverulence on median and intersegmental lines, and lateral portions of all segments, and entire dorsum of head and thorax; antennæ pale brownish yellow on bases of joints, especially the third, otherwise dusky; legs same color, except tarsi, knees, tips of first two pairs of tibiæ and almost entire tibiæ and femora of hind legs; cornicles black; eyes dark brown to black.

Measurements: body 2.9 mm. in length; hind tibia 2.3 mm, tarsus 3 mm.; antenna 1.2 mm.; joints of antenna as follows: I, .09 mm.; II, .08 mm.; III, .50 mm.; IV, .16 mm.; V, .22 mm.; VI, .12 mm. + .04 mm.; sensoria as follows: III, 3–7; IV, 0–2; V, 0–1; unguis conical. Hairs on middle of hind tibia same length and character as apteræ but equalling diameter of tibia, hairs on antenna and body same as apterous. Wings hyaline, stigma and stigmal vein dusky brown, subcostal area slightly smoky.

Oviparous Female. (Plate XXIV, Fig. 14 and Plate XXV, Figs. 9 and 10). Described from fourteen specimens reared on tree on campus, taken October 18, 1916, progeny of fundatrix from Bellevue hills, taken May 19, 1921, above mentioned, and four specimens taken in Estes Park,[2] Colorado, September 18, 1921.

Color: rusty brown marked with four rows of black patches extending from prothorax to cornicles, dark brown on head and prothorax; marked with pulverulence on dorso-lateral portions of thorax and abdomen, on median line, and covering entire dorsum of sixth, seventh, and eighth abdominal segments. That on posterior segments of abdomen is used to cover freshly laid eggs, being transferred to eggs by hind feet of female just after laying egg; legs and antennæ colored as in apterous summer viviparæ. Measurements: body, 2.5 mm.; hind tibia 1.2 mm.–1.5 mm. in length, slightly swollen and covered with slightly raised sensoria. Other characters as in viviparæ.

[1]Altitude, 8,000 feet.
[2]Altitude, 8,000 feet.

Alate Male (Plate XXV, Fig. 11.) Described from two specimens in same collection as above mentioned oviparous female, taken October 18, 1916, and three examples taken in Estes Park,[1] Colorado, September 18, 1921.

Color markings as in alate viviparæ.

Measurements: body, 2 mm. in length; hind tibia, 1.5 mm.; antenna, 1.3 mm.; joints of antenna as follows: III, .40–.50 mm.; IV, .14–.22 mm.; V. .21 mm.; VI, .13 + .03 mm.; secondary sensoria as follows: III, .24; IV, 6; V, 5; all other characters as in alate viviparæ.

Collections were made as follows, all on *Pseudotsuga taxifolia* (Poir.) Britt., feeding on bark of twigs, in Larimer County,[1] by L. C. Bragg, C. P. Gillette, F. C. Hottes and the author.

Fundatrix or Stem Mother: Five collections, May 15[2] to June 26.[3]
Apterous Summer Viviparous Female: Six collections, June 8[2] to August 21.[3]
Alate Viviparous Female: Three collections, June 20[2] to July 26.[3]
Oviparous Female: Four collections from September 12[2] and September 18[3] to November 10.[2]
Alate Male: Three collections, September 12[2] and 18[3] to October 10.[2]

Eggs hatched in Ft. Collins,[4] Colorado, March 31 to after April 4, in 1922. In Estes Park,[5] Colorado, they were found hatching April 20, in the same year.

First fundatrices, from above eggs hatched in Ft. Collins, began to reproduce May 9, became shrunken May 26 and were removed. Time from hatching to maturity 30 to 39 days. They were found reproducing for 15 days. Reared on little tree on campus. First fundatrices, from above mentioned eggs taken in Estes Park, matured May 16, taking 34 days after hatching. Reared in natural temperature house in Ft. Collins.

Second generation in two cases consisted, apparently, of apteræ only. Alatæ appeared in third generation, but were few in number or left the tree soon. The colonies moved frequently and rather simultaneously, to other parts of the tree.

Sexuales appeared about the middle of October in Ft. Collins, but in the middle of September in Estes Park, 3000 feet higher.

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[1]Altitudes from 5,000 to 8,500 feet.
[2]Altitude, 5,000 feet.
[3]Altitude, 8,000 feet.
[4]Altitude, 5,000 feet.
[5]Altitude, 8,000 feet.

Lachnus occidentalis Davidson.

Lachnus occidentalis Davidson. 1909, Jour. Econ. Ent., vol. 2, p. 300, (orig. desc., apteræ). 1910, Davidson, Jour. Econ. Ent., vol. 3, p. 374, (list). 1912, Essig, Pom. Jour. Ent., vol. 4, p. 773 (list). 1912, Wilson, Can. Ent., vol. 44, p. 193 (desc. all forms). 1919, Swain, Univ. of Cal. Tech. Bull. Ent., vol. 3, No. 1, p. 47 (record).

Egg (Plate XXVI, Figs. 1 and 2.) Described from numerous examples taken on needles of *Abies lasiocarpa* (Hook.) Nutt., above Laramie-Poudre Tunnel,[1] Colo., April 8, 1922, several examples taken with oviparæ, south of Long's Peak,[2] Colo., Oct. 21, 1922, and a number of examples taken in insectary, laid by oviparous females, descendants of viviparæ taken at Laramie-Poudre Tunnel Aug. 12, 1922, by F. C. Hottes. Found singly and lengthwise on ventral side of needles, rarely more than one on a needle. Hatched with open end of egg toward base of needle.

Color: light brownish yellow when first laid, changing to jet black in a few days; covered with very slight powder. Measurement: 1.2–1.3 mm. by .5 mm.

Fundatrix or *Stem Mother* (Plate XXVI. Figs. 3 and 4.)

Young. Hatched from first collection of eggs mentioned above.

1st. instar. Color: dark or dusky brown throughout body; legs and antennæ yellowish, before feeding. After feeding (Plate XXVI, Fig. 3) head chocolate (Ridgway 1912), prothorax dusky brown, rest of dorsum bluish black, with six longitudinal rows of pulverulent spots which coalesce later, producing flocculence over entire dorsum except head; legs yellowish, marked with dusky on tips of tarsi; antennæ pale yellowish, dusky at tip.

3rd instar: Same as above except that flocculence covers entire body, including head and is caught on hairs of legs and on adjacent parts of twig, giving the appearance of a colony of *Schizolachnus tomentosus* De Geer. Body color just after moulting yellow olive green.

Adult (Plate XXVI, Fig. 4.) Described from thirty examples reared from young above described, hatched from collection of eggs first mentioned, maturing May 20, 1922.

Color: soon after moulting, dusky olive green shading to brownish on prothorax and head, with two longitudinal rows of dark areas on dorsum extending to cornicles and with white secretion as follows: entire head, patch covering most of prothorax, a smaller on median portion of mesothorax and six longitudinal rows of spots extending from mesothorax to tip of abdomen. In a day or so after moulting these spots coalesce and the insect is covered with rather abundant flocculent secretion, which catches on the long hairs of the legs and is spread to the surrounding portions of the twig. Cornicles green to black; legs pale yellowish with distal half of tarsi and extreme tips of tibiæ black or blackish, antennæ pale with only tips dusky.

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[1]Altitude, 8,000 feet.
[2]Altitude, 9,000 feet.

Measurements: body, 2.5 mm.–3 mm. by 1.5–2 mm.; hind tibia, 1.1 mm.; tarsus, .36 mm.; antenna, 1 mm.; joints of antenna as follows: III, .27–.33 mm.; IV, .12–.16 mm.; V, .15–.19 mm.; VI, .13–.15 + .03 mm.; secondary sensoria none. Beak attaining second abdominal segment, terminal joints rather stout in appearance, measuring, .16, .13, and .05 mm. respectively. Cornicles small, .17 mm. in diameter at base. Unguis conical, moderately slender. Hairs on middle of outer side of hind tibia, fairly numerous, fine, erect, long, attaining .18–.22 mm. in length, two to three times the diameter of the tibia; hairs on third joint of antenna similar to above, attaining length of .13 mm., or three times the diameter of the joint; hairs on body fairly abundant, erect, fine, and attaining .10 mm. in length; ocular tubercles not evident.

Apterous Summer Viviparous Female (Plate XXV, Fig. 17.) Described from numerous examples reared from above fundatrices and maturing June 14, 1922, and twenty specimens taken Aug. 12, 1922, at same locality as eggs above mentioned by F. C. Hottes. Both young and adults of same color and measurements as fundatrix after first moult.

Alate Viviparous Female: (Plate XXVI, Fig. 5, and Plate XXV, Figs. 20 and 21.) Described from thirty-two examples reared along with above apteræ from above mentioned fundatrices, and matured June 10 to 14, 1922; and from a single specimen taken Aug. 12, 1922 along with the apterous viviparæ above mentioned for same date.

Color: head and thorax cinnamon brown to blackish, abdomen light olive green, cornicles concolorous with abdomen but with black tips; entire dorsum and venter developing flocculent pulverulence. This catching on the long hairs of the antennæ and legs causes a very tomentose appearance. Legs and antennæ very pale yellowish brown, dusky on distal half of tarsi and on knees, tips of tibiæ slightly brownish. Wings hyaline; stigma, stigmal and costal veins pale dusky yellowish; costal cell pale yellowish.

Measurements: body, 2 mm.; hind tibia, 1.3 mm.; tarsus, .37 mm.; antenna, 1–1.1 mm., joints of antenna as follows: III, .30–.35 mm.; IV, .15–.17 mm.; V, .17–.20 mm.; VI, .15 mm. + .04 mm. Beak attaining second to fourth segment of abdomen, terminal joints rather stout, measuring .16, .13, and .05 mm. respectively; cornicles small, .15 mm. in diameter at base of cone; length of wing 3.5–4 mm. Secondary sensoria small, located as follows: on joint III, 1–3; IV, 2–3; V. 0; unguis slender conical. Hairs on outside of middle of hind tibia fairly numerous, fine, erect or nearly so, long, attaining .20 mm. in length, or three times the diameter of the tibia; hairs on third joint of antenna moderately numerous, nearly erect, attaining length of .10 mm. or twice the diameter of the joint; hairs on body and cornicles same as on antenna. Fore wing with media very faint, twice forked. A few exceptions to this occurred, four out of twenty-nine had one or both wings once forked and one out of twenty-nine had media simple. Hind wing with two cross veins. Eyes prominent, without evident ocular tubercles.

Alate Male (Plate XXV, Fig. 22.) Described from five examples reared in insectary from apterous viviparæ taken at Laramie-Poudre Tunnel, Aug. 12, 1922, by F. C. Hottes, and maturing Sept. 16, 1922.

Color: same as alate viviparous female.

Measurements: body, 1.6 mm., slender; wing, 2.9 mm.; hind tibia, .90 mm.; tarsus, .28 mm.; antenna, .90 mm.; joints of antenna as follows: III, .30–.33 mm.; IV, .12–.14 mm.; V, .14 mm.; VI, .13 + .03 .mm.; secondary sensoria as follows: III, about 18; IV, 12; V, 5; unguis slender conical. Hairs on hind tibia rather numerous, fine, erect, long, attaining .15 mm. in length or three times diameter of tibia; hairs on antenna similar to those on hind tibia, .07 mm. long, rather numerous. Beak attaining middle of abdomen; cornicles .08 mm. in diameter at base of cone. Eyes without ocular tubercles. Wing with media twice branched, though a few were found once branched.

Apterous Oviparous Female (Plate XXV, Fig. 23 and Plate XXVI, Fig. 6.) Described from twelve examples reared along with above males, progeny of apterous viviparæ taken Aug. 12, 1922, on Abies at Laramie-Poudre Tunnel, by F. C. Hottes and maturing Sept. 16.–17, 1922, and twenty six examples taken on *Abies lasiocarpa*, in Wild Basin south of Long's Peak, Colorado, October 21, 1922.

Color: same as fundatrix.

Measurements: same as apterous viviparæ and fundatrix, or slightly smaller, except that hind tibiæ are slightly swollen and covered with numerous convex sensoria throughout entire length. Hairs as in fundatrix.

Collections were taken as follows, all on bark of twigs of *Abies lasiocarpa* (Hook.) Nutt., in Larimer and Boulder counties[1] by E. Bethel, F. C. Hottes, and the author.

Eggs, (on needles): Three collections, September 16[2] to April 10.[2]
Fundatrix or Stem Mother: Three collections, June 11[3] to July 7.[3]
Apterous Summer Viviparous Female: Five collections, July 12[3] to Sept. 16.[2]
Alate Viviparous Female: Five collections, June 10[2] to September 16.[2]
Apterous Oviparous Female: Three collections, September 16[2] to October 21.[3]
Alate Male: One collection, September 16.

Egg laying habit differs from that of most other Lachnids in that eggs are laid singly on ventral side of needle, rarely more than one on a needle, instead of five to eight in a row on dorsal side of needles. First hatching record[4] was April 20, 1922. Fundatrices matured from said eggs May 20, or in 30 days from hatching. Second generation, both alate and apterous, matured June 14, or in 25 days from birth. Alatæ were quite numerous, equalling, if not exceeding the numbers of the apteræ. The

[1]Altitudes from 8,500 to 9,500 feet.
[2]Altitude, 8,500 feet.
[3]Altitude, 9,500 feet.
[4]Altitude, 5,000 feet.

first sexuales appeared in the insectary September 16, 1922, reared from apterous summer viviparæ taken August 12 of same year. Sexuales taken in nature appeared October 21, 1922.

This species is very quiet in habit, not easily disturbed, nor given to much wandering about, even if the twig upon which they feed becomes rather dry. They are found in quite large colonies and are a rather common species. They have the peculiar habit of migrating on to needles when ready to moult, so that empty skins are found on needles, while the insects themselves are always found feeding on bark of twig. These skins, together with scattered flocculent material give the twig an ashy appearance by which the colony may easily be detected.

Lachnus oregonensis Wilson.

Lachnus oregonensis Wilson. 1915, Trans. Am. Ent. Soc., vol. 41, p. 103 (orig. desc.). 1919, Swain, University of Cal. Tech. Bull., Vol. 13. p. 48 (record).

Egg (Plate XXVI, Fig. 12.) Described from numerous examples taken on cones of *Pinus Murrayana* Eng., in Bellevue foot hills,[1] April 22, 1922, by J. L. Hoerner, and several laid in insectary September 10, 26, 1922, on cones taken in Estes Park,[1] Colo., September 1, 1922. Found on young cones, mostly on under side and at bases of scales.

Color: light yellowish brown when first laid, turning black in a few days, shining. Size: 1.5 by .5 mm.

Fundatrix or *Stem Mother:*

Young, 1st instar (Plate XXVI, Fig. 7.) Described from a number of specimens hatched April 22, 1924, from first collection of eggs above mentioned. Feeding on young cones where eggs were laid.

Color: deep flesh or cinnamon rufous, head and diagonal lines extending dorso-laterally over prothorax dark brown, dorsum of segments three to six of abdomen dusky brown; antennæ and legs dark brown, tarsi and tips of antennæ blackish; eyes black; body, except head, slightly pulverulent. Beak but little surpassing hind coxæ.

Adult (Plate XXVI, Fig. 8.) Described from twenty-five specimens reared from first collection of eggs above mentioned, maturing from May 13–22, 1922. Feeding on same cones as above.

Color: yellowish brick red or ferruginous tinged with dusky dark dashes on dorsum of meso- and metathorax and first, seventh and eighth segments of abdomen; eyes dark brown; legs and antennæ light honey yellow or pale yellow, tinged with cohre, with tarsi and sixth joint of antenna black, knees and distal two-thirds of femora brownish, tips of pro- and mesothoracic and distal one-third to one-half of metathoracic tibiæ, cornicles, tips of antennal joints three, four and five, and entire sixth dusky to blackish, dorso-lateral portion of abdomen with two longitudinal rows of black dots; no pulverulence, surface shining.

[1]Altitude, 8,000 feet.

Measurements: Body, 2.5–2 mm. by 1.3–1 mm., pyriform; length of hind tibia 1.5–1.6 mm.; antenna, .9 mm. in length; joints of antenna as follows: III, .30–.35 mm.; IV, .09–.11 mm.; V, .11-.14 mm.; VI, .10–.13 mm.+.04 mm.; secondary sensoria located as follows: III, 0–1; IV, 0–1; V, 0–1; unguis bluntly conical; cornicles very small, base.10–.13 mm. in diameter; beak about same length as body, terminal joints measuring .19, .22, and .09 mm. respectively. Hairs on hind tibiæ fairly numerous, fine, erect, moderately long, .09 mm. in length, or exceeding diameter of tibia; hairs on antennæ similar to those on tibia, but somewhat shorter, .07–.08 mm. in length, or more than twice the diameter of the joint; hairs on body same as those on antennæ.

Apterous Summer Viviparous Female, (Plate XXVIII, Figs. 1, 3 and 4). Described from four examples taken on cones of *Pinus Murrayana,* in Estes Park,[1] Colo., Aug. 25, 1921, six samples of second generation reared from fundatrices described above and matured June 10 to 16, 1922. Feeding on same cones as fundatrices.

Young, 1st instar: In newly born, color lemon yellow throughout. After feeding, color pale dusky yellow with slight pulverulence, head and pair of spots on prothorax brown. Color very much the same as young fundatrix, except that the legs are without dusky coloration.

Adult. Color, light brick red to ferruginous throughout dorsum, with less inclination to dusky than fundatrix; legs and antennæ as in fundatrix.

Measurements: Same as fundatrix.

Alate Summer Viviparous Female, (Plate XXVI, Fig. 9, and Plate XXVIII, Figs. 2, 5 and 6). Described from 36 examples reared from fundatrices described above. Fed on same cones as fundatrices till maturity then flew away in search of the new cones then forming.

Color: abdomen light brick to ferruginous as in apterous, cornicles hardly darker than abdomen, head and thorax dark brown to black, two anterior sclerites of metathorax covered with white powdery secretion; legs dusky to black throughout except proximal one-fourth of femora and proximal half of pro- and mesothoracic tibiæ, which are ochraceous buff (Ridgeway, 1912); antenna same color, but paler with entire sixth and tips of third, fourth and fifth joints dusky; stigma, stigmal vein and costal veins cinnamon brown, costal cell smoky.

Measurements: body, 2.5 by .9 mm.; wing, 3.4–3.9 mm. long; hind tibia, 1.6–2 mm.; hind tarsus, .33 mm.; antenna, .8–1 mm.; joints of antenna as follows: III, .28–.40 mm.; IV, .10–.16 mm.; V, .12–.19 mm.; VI, .09–.11 mm.+.04 mm.; secondary sensoria as follows: III, 2–6; IV, 0–2; V, 0–1; unguis conical. Beak distinctly surpassing tip of abdomen in length, cornicles, .12 mm.–.15 mm. in diameter at base of cone. Hairs on outer side of hind tibia fine, fairly numerous, erect, .05–.07 mm. in length, or twice as much as the diameter of tibia; hairs on third joint of antenna fairly numerous, erect, .05–.07 mm. in length, or twice as long as diameter of joint; hairs on body and cornicles same as on antennæ. Secondary sensoria about as large as primary sensoria.

[1]Altitude, 8,000 feet.

Media of fore wing faint and twice branched, i. e., with three forks; hind wing with two cross veins.

Apterous Male, (Plate XXVI, Fig. 10 and Plate XXVIII, Fig. 7). Described from twelve specimens reared from sexuparæ on cones of *Pinus Murrayana*, taken in Estes Park,[1] Colorado, September 1, 1924, and maturing September 10 to 15. Feeding on young cones.

Color: Same as apterous summer viviparæ in general, but head and entire legs dusky and antenna slightly more dusky. Dorsum covered with light coat of powdery secretion.

Measurements: body, 1.5 by .6 mm.; hind tibia, 1–1.1 mm.; hind tarsus, .27 mm.; antenna, .7 mm.; joints of antenna as follows: III, .27 mm.; IV, .11 mm.; V, .13 mm.; VI, .09 mm.+.04 mm.; secondary sensoria as follows: III, 2; IV, 2; V, 2. Hairs on hind tibia rather sparse, .07 mm. in length, or twice as long as the diameter of the tibia. Beak surpassing tip of abdomen about as much as half of the body. Other characters as in viviparæ.

Oviparous Female, (Plate XXVI, Fig. 11). Described from two examples taken on little cones of *Pinus Murrayana*, in hills near Bellevue,[2] October 2, 1921, and six examples reared along with males described above.

Color: Same as apterous summer viviparæ, being distinguished from the latter only by the powdery tip to the abdomen, covering dorsum of seventh and eighth segments.

Measurements: Same as in summer viviparæ, excepting the slightly longer abdomen. The hind tibiæ show no perceptible swelling nor any evident sensoria. If sensoria are present they are very flat and indistinct.

Collections were taken as follows, all on young cones of *Pinus Murrayana* Eng., in Larimer and Boulder Counties, Colorado, by C. P. Gillette, J. L. Hoerner, and the author.

Egg: Two collections, September 26 and April 22.
Fundatrix or Stem Mother: One collection, May 13, reared from eggs taken April 22.
Apterous Summer Viviparous Female: Five collections, June 16 to Sept 10.[3]
Alate Viviparous Female: Two collections, June 14[3] and June 23.[4]
(*Apterous*) *Male:* One collection, September 15.
Oviparous Female: Two collections, October 2 and September 26.

This species is comparatively rare, but where present, it occurs in large crowded colonies. They are quite difficult to find on account of the perfect protective coloration, making necessary the closest inspection unless the presence of the aphids is betrayed by attendant ants. They have been found feeding on the youngest growth of cones.

[1]Altitude, 8,000 feet.
[2]In altitude of about 8,000 feet.
[3]Reared in insectary from fundatrices mentioned above.
[4]Altitude, 8,730 feet.

Eggs were found hatching at altitude of 8,000 feet on April 22, in 1922. When reared at altitude 5,000 feet in natural temperature house fundatrices matured May 13, i. e., in 23 days. Adult second generation viviparæ, alate and apterous, appeared June 5, i. e., in 23 days. The second generation were almost all alate. The apteræ were so few as to raise the question as to whether they might be belated fundatrices, which, however, seemed rather unlikely as they were taken a week after the alate second generation had been starting to migrate. The alatæ all left the cones, evidently in search for the new cones which would be appearing in nature simultaneously with the development of this generation. After settlement on the new cones probably only apterous forms occur, as four collections taken in July and August contained no alate. The males matured September 15 in the natural temperature insectary in Ft. Collins, appearing before the oviparæ matured sufficiently to be distinguished and disappearing by the time the oviparous individuals began to show the white tip to the abdomen. The females matured in this case September 26, and eggs were found on this date.

Lachnus edulis Wilson.

Lachinella edulis Wilson. 1919, The Can. Ent., vol. 51, p. 44.

Egg, (Plate XXVII, Figs. 2 and 2 a). Described from numerous examples taken on needles of *Pinus edulis* (Engelm.) Small., in Owl Canon,[1] Larimer County, Colo., March 26, 1922, by C. P. Gillette, J. L. Hoerner, and the author. Found laid on the upper side of needles, in longitudinal rows of six to eight in a row, placed end to end. Hatching with open end toward base of needle.

Color, jet black, without powder. Length, 1.35 mm.

Fundatrix, or Stem-Mother:

Young. Reared from above-mentioned eggs.

1st instar. Before feeding (Plate XXVII, Fig. 3), color dark olive green or black throughout dorsum; legs, antennæ and beak pale dusky yellowish; tarsi, terminal joints of beak and tips of antennæ darker. After a few days (Plate XXVII, Fig. 4) dorsum covered evenly with white powder on thorax and abdomen; head black with only median and lateral lines white; legs pale orange yellow (Ridgeway, 1912) tinged with dusky, darker on tarsi and tips of tibiæ.

2nd instar: With decided median white line throughout dorsum, remainder of body bare in spots, giving mottled effect.

3rd instar: About the same color as adult.

[1]Altitude, 5,600 feet.

Adult. Described from eleven examples reared from above eggs and maturing April 18, 1922.

Color and measurements same as apterous summer viviparæ.

Apterous Summer Viviparous Female:

Young (Plate XXVII, Fig. 5). Described from numerous examples born from fundatrices described above.

1st instar: Color: when just born, dark brown mottled with rusty brown on abdomen; later, similar with light, almost flesh-colored median stripe extending from head to tip of abdomen; head black and shining except median and lateral lines which are pale, prothorax pale with two pairs of dorso-lateral black areas, meso- and metathorax pale; tarsi, knees, tips of tibiæ, antennæ, and terminal joints of beak black or blackish; legs pale yellow, almost colorless; entire dorsum slightly pulverulent, white more pronounced on median line, black areas on head and thorax naked. Beak extending beyond tip of abdomen by as much as a quarter of the body.

Adult (Plate XXVII, Fig. 6, and Plate XXVIII, Figs. 8, 9, 11, and 12.) Described from numerous examples reared from fundatrices described above and matured May 27, 1922, and from eleven examples taken on twigs of *Pinus edulis*, In Owl Canon, Larimer County, Colo., August 6, 1922, by C. A. Bjurman, and eighteen examples taken in same location September 25, 1921.

Color: shining black, more or less polished on thorax, lateral margins and terminal segments of abdomen, and cornicles, white secretion evident only on median line; legs light orange yellow, with knees, tarsi, distal ends of pro- and mesothoracic and two thirds of metathoracic tibiæ black; antennæ same color as legs, with tips of joints three, four, and five and entire sixth dusky.

Measurements: body, 2.5–.3 mm.; hind tibia, 2.5–.3 mm.; hind tarsus, .3 mm.; antenna, 1.3–1.5 mm.; joints of antenna as follows: III, .42–.55 mm.; IV, .22–.25 mm.; V, .20–.25 mm.; VI, .08–.11 mm. + .05 mm.; secondary sensoria as follows: III, .0–1[1]; IV, 0–1; V, 1; unguis short and thick conical. Hairs on outside of hind tibia fine, numerous, drooping, set at an angle of 45 degrees, attaining .08 mm. in length, or length hardly the same as diameter of tibia; hairs on third joint of antenna attaining .05–.07 mm. in length, not very numerous, set at an angle of 45 to 60 degrees; hairs on body and cornicles same as on antenna. Cornicles .55 mm. in diameter at base; beak attaining cornicles, terminal joints measuring .19, .16, and .06 mm.

Alate Viviparous Female (Plate XXVII, Fig. 7, and Plate XXVIII, Fig. 10.) Described from ten examples reared from young born of fundatrices described above, and from thirteen examples taken in Owl Canon, Larimer County, Colo., August 6, 1922.

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[1]This differs from original description by Wilson, which gives three sensoria for third antennal joint of apterous viviparous female. The three sensoria must be an exception as they do not appear in any of the twenty-five examples, in the Colo. Exp. Sta. collection, taken in same lot as those submitted to Mr. Wilson, and from which he made his description.

Color: thorax and abdomen black or bluish black, head dark brown; abdomen with median line of white secretion; legs as in apterous viviparæ; stigma and costal vein dusky brown, costal cell smoky.

Measurements: body 3–3.5 mm. by 1.4 mm.; hind tibia, 2.5 mm. to .3 mm.; hind tarsus, .3 mm.; antenna, 1.2 mm.; joints of antenna as follows: III, .34–.60 mm.; IV, .20–.30 mm.; V, .22–.30 mm.; VI, .13 + .04 mm.; secondary sensoria as follows: joint III, 3–6; IV, 2–3; V, 1; unguis short, thick, and conical. Hairs as in apterous, or slightly shorter. Beak attaining cornicles, measurement of joints same as in apterous; cornicles .30–.40 mm. in diameter at base, darkening more pronounced in diameter of .20 mm. Fore wing with media twice forked, *i. e.*, with three branches; hind wing with two cross veins.

Alate Male (Plate XXVIII, Fig. 13.) Described from a single specimen taken on bark of twigs of *Pinus edulis*, in Owl Canon, Larimer County, Colo., October 27, 1921, by C. P. Gillette.

Color: from description in manuscript by C. P. Gillette, "Color throughout black, wings slightly smoky, costal margins and stigma smoky brown." Length of wing 2.80 mm."

Measurements: body, 1.5 mm.; antenna, 1.05 mm.; joints of antenna as follows: III, .43 mm.; IV, .21 mm.; V, .25; VI, .12 + .03 mm.; secondary sensoria as follows: III, 50; IV, 20; V, 10; hairs as in alate viviparæ.

Apterous Oviparous Female (Plate XXVII, Fig. 1, and Plate XXVIII, Figs. 14 and 15.) Described from thirty-eight examples taken on twigs of *Pinus edulis*, in Owl Canon, Larimer County, Colo., October 27, 1921, by C. P. Gillette.

Color: same as apterous summer viviparous female.

Measurements: body, rather elongate, 3–4 mm. by 1.75 mm.; hind tibia, 1.8–2.2 mm., bearing numerous small convex sensoria throughout entire length. Hairs as in summer viviparæ.

Collections were made as follows, all on bark of twigs and branches of *Pinus edulis* (Engelm.) Small., in northern part of Larimer County, Manitou, Salida, Walsenberg and Grand Junction,[1] Colo., by L. C. Bragg, C. P. Gillette, C. A. Bjurman, J. L. Hoerner, F. C. Hottes and the author.

Egg, (on needles): One collection, March 26.
Fundatrix or Stem Mother: Three collections, May 24 to June 8.
Apterous Summer Viviparous Female: Eight collections, May 27 to Sept. 25.
Alate Viviparous Female: Six collections, May 27 to September 18.
Alate Male: One collection, October 27.
Oviparous Female: Two collections, October 18 and 28.

This is the most common and generally distributed species of aphid on *Pinus edulis*, and it occurred in injurious numbers at Sweetwater, California, in August, 1922, where it was reported by E. Bethel as killing thousands of trees.

[1]Altitude, 5,000 to 7,000 feet.

Eggs were found hatching March 26, 1922, from these fundatrices matured April 18, i. e., in 23 days. Second generation viviparæ matured May 27, 39 days later, but probably were not descended from the earliest fundatrices as these were mounted when found. The earliest date for taking sexuales was October 18. The second generation consisted of both apteræ and alatæ in about equal numbers.

Lachnus vandykei Wilson.

Lachniella vandykei Wilson. 1919, Can. Ent., vol. 51, p. 19, (orig. desc.) (alate and apt.).

Egg. Described from several examples taken on needles of *Picea engelmanni* (Parry) Engelm., in Estes Park,[1] Colo., June 11, 1923, by F. C. Hottes. Found singly or in twos on the needles, mostly at the very bases.

Color: shining black, without pulverulence. Size, .50 by 1.15 mm.

Fundatrix, or *Stem Mother:*

Young, 3rd instar, taken with the above mentioned eggs. Color same as adult.

Adult. Described from two specimens taken on *Picea engelmanni*, at Chamber's Lake,[1] Colo., June 30, 1923 and from seven specimens taken on Fall River,[2] Estes Park, Colo., July 7, 1923, on same host.

Color: dark rufous brown to metallic black throughout, dorsum entirely without pulverulence; legs mostly black shading to dusky yellowish near bases of tibiæ and femora; antenna dusky throughout except basal two thirds of third joint; cornicles black.

Measurements: same as summer apterous viviparæ.

Apterous Summer Viviparous Female:

Young. Born from above mentioned fundatrices, taken in Estes Park, Colorado. 1st instar, head and thorax very pale, abdomen somewhat pink, with two green lines down dorsum. 2nd and 3rd instars, color similar to adult, or slightly more yellowish.

Adult (Plate XXVII, Fig. 8, and Plate XXVIII, Figs. 18 and 19.) Described from ten specimens, progeny of fundatrices above mentioned from Estes Park, reared in the insectary, and seven specimens taken on Flat Top Mountain,[3] Estes Park, Colo., July 16, 1923.

Color: same as fundatrix, unless lighter and more brownish.

Measurements: body 2.5 by 1.5 mm.; robust; hind tibia, 1.7 mm.; hind tarsus, .35 mm.; antenna, 1.25 mm.; joints of the same as follows: III, .50 mm.; IV, .19 mm.; V, .20–.25 mm.; VI, .16+.03 mm.; secondary sensoria as follows: III, 2; IV, 1–2; V, 1; unguis conical. Hairs on middle of hind tibia nearly erect to erect, fine, numerous, .10 mm. long,

[1]Altitude, 9,000 feet.
[2]Altitude, 10,000 feet.
[3]Altitude, 9,500 feet.

exceeding diameter of tibia; hairs on antenna similar, length equalling twice the diameter of joint; hairs on body and cornicles similar. Cornicles from .30–.50 mm. in diameter.

Alate Viviparous Female. (Plate XXVII, Fig. 9, and Plate XXVIII, Figs. 16 and 17.) Described from four specimens reared in the insectary, from young born of fundatrices above mentioned, taken in Estes Park, Colorado, maturing July 17, 1923, and ten specimens taken along with apterous viviparæ above mentioned, on Flat Top Mountain,[1] Estes Park, Colorado, July 16, 1923.

Color: thorax black, abdomen dark brown mottled with yellowish, sometimes with large yellowish area on median portion of first and second abdominal segments; legs black except bases of femora and small proximal portion of first and second pairs of tibiæ; cornicles and eyes black; pulverulence appearing in slight dashes on intersegmental lines, large white area on dorso-lateral portions of fourth abdominal segment, just anterior to cornicles, entire dorsum of seventh abdominal segment, cauda, and entire scutellum.

Measurements: body, .3 mm. long; hind tibia, 1.6 mm.; hind tarsus, .37 mm.; antenna, 1.2 mm.; joints of same as follows: III, .45–.55 mm.; IV, .18 mm.; V, .21–.25 mm.; VI, .15 + .04 mm.; secondary sensoria as follows: III, 6–10; IV, 3–2; V, 1–2. unguis conical. Hairs as in apterous form, those on outer side of tibia almost twice the diameter of tibia in length; cornicles moderately large, .50 mm. in diameter at base. Wing hyaline except subcostal area, which is dusky, stigma, stigmal vein, and costal vein dark dusky.

Oviparous Female (Plate XXVII, Fig. 10, and Plate XXVIII, Fig. 20.) Described from eight specimens reared in insectary descendants of fundatrices taken in Estes Park, Colorado, above mentioned, maturing July 20, 1923, and four specimens taken in Pingree Park,[2] Colo., August 24, 1923, and one specimen taken along Fall River,[3] Estes Park, Colo., July 27, 1923.

Color: same as apterous viviparæ, except dorsum of entire tip of abdomen posterior to cornicles is thickly covered with pulverulence; cornicles black.

Measurements: body, 2–2.25 mm., pyriform; hind tibia, 1.2 mm., covered with numerous flat sensoria. Other characters as in viviparæ.

Apterous Male (Plate XXVII, Fig. 11 and Plate XXVIII, Fig. 21.) Described from a single specimen taken July 20, 1923, in same colony as oviparæ mentioned above, reared as descendants of fundatrices from Estes Park, above mentioned.

Color: dark brown throughout without pulverulence; legs and antennæ as in oviparous female.

Measurements: body, 1.9 by 1 mm., slender; hind tibia, 1.2 mm.; hind tarsus, .30 mm.; antenna, 1.1 mm.; joints of the same as follows: III, .40 mm.; IV, .16 mm.; V, .20 mm.; VI, .14 + .03 mm.; secondary sensoria numerous, rather thickly covering III, IV, and V, about eight to a joint. Hairs and other characters as in other forms.

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[1]Altitude, 9,500 feet.
[2]Altitude, 9,000 feet.
[3]Altitude, 10,000 feet.

Collections were made as follows, on bark of twigs of *Picea engelmanni* (Parry) Engelm., in Larimer County[1] by C. P. Gillette, F. C. Hottes and the author.

Egg, (on needles, hatched): One collection, June 11.
Fundatrix or Stem Mother: Three collections, June 11 to July 7.
Apterous Summer Viviparous Female: Three collections, July 16 to July 28.
Alate Viviparous Female: Two collections, July 16 to July 26.
Apterous Oviparous Female: Two collections, July 20 to August 24.
Apterous Male: One collection, July 20.

Fundatrices became mature in Estes Park,[2] about June 15 in 1923, and were found still reproducing at Chamber's Lake,[3] Poudre River, Colorado, June 30, 1923. Adult apterous and alate second generation females were taken in the insectary July 17, 1923, the alate forms appearing in the proportion of about 50%. Sexuales appeared in this same colony July 21, 1923, apparently in second generation. The oviparous female taken on Flat Top Mountain,[1] Estes Park, on July 27, same year, must have been second generation also.

This early appearance of sexuales was very unusual, but the collection of the same in nature within a week of their appearance in the insectary precludes the possibility of it being the effect of unnatural conditions.

This species occurs in small colonies, but is not common.

Lachnus schwarzii Wilson.

Lachniella schwarzii Wilson. 1919, Can. Ent., vol. 51, p. 46, (orig. desc.)

Egg (Plate XXIX, Fig. 1.) Described from numerous examples taken on needles of *Pinus scopulorum* (Engelm.) Lemmon., in Owl Cannon,[4] Larimer Co., Colorado, March 26, 1922. Found laid in rows lengthwise of the needles, end to end. Hatching with open end toward tip of needle.

Color: shining black, without powder. Size: 1 by .47 mm.

Fundatrix, or *Stem Mother:*

Young. 1st instar (Plate XXIX, Fig. 2.) Hatched from above mentioned eggs. When newly hatched, color, very dark cinnamon brown, nearly black, sometimes with greenish tinge; legs and antennæ at first pale yellowish, then turning very dark and shining. Beak very long, exceeding the length of the body by over half. When two or three days old, (Plate XXIX, Fig. 3 and 4) color, slightly lighter brown, and covered with white powdery secretion, which is often broken into

[1]Altitude, 9,500 feet.
[2]Altitude from 9,000 to 10,000 feet.
[3]Altitude, 9,000 feet.
[4]Altitude, 5,600 feet.

patches giving a mottled effect; head dark with median stripe, lateral portions, and band across face ventral to compound eyes covered with white secretion; two black areas on dorsum of prothorax and four rows of black dots on dorsum of abdomen; legs blackish except yellowish ring just below knees; antennæ pale except entire first, second, and sixth and tips of remaining joints, which are blackish. Covered with numerous fine hairs.

Adult (Plate XXIX, Fig. 5.) Described from twenty examples reared from eggs described above and maturing April 28 to May 4.

Color: cinnamon brown, mottled with blackish and marked with scattered patches and streaks of powder, broken median line of white from fifth abdominal segment to cauda; cornicles black; legs black or blackish, except proximal ends of femora and pale yellow band just below knees on tibiæ; antennæ pale yellow, with entire first, second, and sixth and tips of third, fourth, and fifth joints dusky to black.

Measurements: body, 3–4 mm. by 1.5–2 mm.; hind tibia, 1.6–1.9 mm.; hind tarsus, .28 mm.; antenna, 1–1.2 mm.; joints of same as follows: III, .42–.48 mm.; IV, .15–.20 mm.; V, .19–.25 mm.; VI, .11 − .13 mm. + .05 mm.; secondary sensoria as follows: III, 0; IV, 0; V, 1; unguis short and bluntly conical. Hairs on outside of middle of hind tibia numerous, fine, drooping, at an angle of 30 degrees or less, short, .03–.05 mm. in length, shorter than diameter of tibia; hairs on third joint of antenna rather sparse, at angle of 45 degrees to erect, .05–.07 mm. in length, longer than diameter of joint; hairs on body and cornicles about the same as on antenna. Beak attaining to between first and fifth abdominal segments, terminal joints rather stout, measuring .20, .20, and .07 mm. in length, respectively. Cornicles medium in size, .35–.40 mm. in diameter at base of cone.

Apterous Summer Viviparous Female:

Young. Described from numerous examples born from above mentioned fundatrices April 27, 1922.

1st instar. (Plate XXIX, Fig. 6.)

Color: straw yellow (Ridgway 1912) to cream color (Ridgway 1912), tinged with greenish on areas on dorso-lateral portions of first and second abdominal segments, and tinged with brownish on median portion of abdomen, also on lateral and posterior portions; head dark brown excepting median line and lateral portions which are same color as body; prothorax with a pair of dark brown diagonal areas; bases of cornicles, eyes, lateral portions to almost entire dorsum of eighth abdominal segment, anal plate, and four longitudinal rows of dots on dorsum of abdomen black; legs and antennæ very pale yellowish or water white with knees, tarsi, tips of tibiæ and of antennal joints and entire sixth dusky to black; slight coat of powdery secretion appears later, after feeding. Beak exceeding tip of abdomen by about one half the length of the body, pale colorless, with two distal joints dusky.

2nd instar.

Color: dusky or rusty brown, mottled with darker brown or blackish spots, especially on lateral portions of body, and covered throughout with a light coat of powdery secretion; legs pale with tarsi, knees, distal

half to three quarters of tibiæ dusky to blackish, sometimes distal portion of hind femora more or less dusky. Cornicles black. Beak extending beyond tip of abdomen as far as one fourth the length of the body.

3rd instar. (Plate XXIX, Fig. 7.)

Color: brown or black throughout, covered with mottled or reticulated pattern of white secretion, heavier on median line and on lateral portions of occiput and prothorax; legs brown to black throughout, excepting pale yellow portion distad to knees; antennæ pale yellowish to colorless, except entire first, second, and sixth and tips of third, fourth, and fifth joints dusky to black; eyes dark brown to black.

Adult. (Plate XXIX, Fig. 11, and Plate XV, Figs. 23, 24, and 25.) Described from seventeen examples matured May 13 to 19, 1922, from above mentioned young born of fundatrices described above, and from two examples taken August 15, 1916, in hills near Ft. Collins[1] and three others taken August 2, 1917 at Log Cabin, Colorado by L. C. Bragg and fourteen taken at Log Cabin,[2] Colorado, August 21, 1919, by L. C. Bragg.

Color: dark brown to black on dorsum, powdery secretion mostly confined to broken medio-dorsal line and whitish areas on lateral margins of thorax and abdomen; almost no white evident in older examples; legs black throughout except pale yellowish area below knees; antennæ pale yellowish with usual parts dusky to black.

Measurements: body, 3–4 mm.; hind tibia, 2.1–3 mm.; hind tarsus, .35 mm.; antenna, 1.2–1.6 mm.; joints of the same as follows: III, .45–.65 mm.; IV, .20–.32 mm.; V, .20–.33 mm.; VI, .10–.15 mm. + .04 mm.; secondary sensoria as follows: III, 0–1; IV, 1–2; V, 1; unguis short and thick conical. Hairs as in fundatrix. Beak attaining middle of abdomen. Cornicles about .50 mm. at base of cone.

Alate Viviparous Female:

Young. In early instars indistinguishable from young of apterous form, later distinguished by the presence of wing pads.

Pupa (Plate XXIX, Figs. 8 and 9.) Described from many examples reared as progeny of fundatrices described above and others as progeny of apterous summer viviparæ, August 15, 1916.

Color: rusty brown to gray on abdomen and with mesothorax pale dirty white to pale brownish; head blackish with median and lateral lines of white secretion and light covering or reticulation over remainder of occiput; prothorax black laterally with broad median pale area, more or less covered throughout with secretion; abdomen mottled with black, especially on median portions of fourth and fifth abdominal segments, and lateral patches on all abdominal segments; wing pads and cornicles black; abdomen with slight powdery markings, especially on median line; legs colorless or pale yellowish on area distad of knees, pro- and mesothoracic femora, and base of metathoracic femora, remaining parts of legs black or blackish. Eyes dark brown. Beak exceeding body by about one third length of abdomen.

[1]Altitude, 6,000 feet.
[2]Altitude, 7,500 feet.

Adult. (Plate XXIX, Fig. 10 and Plate XXVIII, Figs. 26 and 22.) Described from thirty-seven examples, reared as progeny of above mentioned fundatrices, five examples taken in hills[1] near Ft. Collins, August 15, 1916, by L. C. Bragg, and ten examples taken at Log Cabin,[2] Colorado, by the same collector, August 16, 1917.

Color: abdomen yellowish brown to black, head and thorax black; very slight powdery secretion present, often evident only in depressions on head and thorax, and median line and lateral dashes on abdomen; legs black except pale yellowish area below knees; antennæ black except bases of third, fourth, and fifth joints; stigma, costa, and subcosta dusky brown; costal cell, and small area at tips of radial sector and at tips of first and second discoidals slightly smoky.

Measurements: body 2.6–4 mm.; wing, 3.5–4 mm.; hind tibia, 2.7–3 mm.; hind tarsus, .32 mm.; antenna, 1.2 mm.; joints of the same as follows: III, .43–.54 mm.; IV, .21–.29 mm.; V, .20–.30 mm.; VI, .10–.15 mm. + .04 mm.; secondary sensoria irregular and somewhat tuberculate, distributed as follows: III, 3–7; IV, 1–2; V, 1; unguis short and conical. Hairs as in apteræ. Beak attaining or extending slightly beyond tip of abdomen, terminal joints measuring .23, .23, and .06 mm. in length respectively. Cornicles .35–.40 mm. in diameter at base of cone. Fore wing twice branched, i. e., with three branches; hind wing with two cross veins. Hind tibia sometimes strongly bent and other times only gently curved.

Alate Male (Plate XXIX, Fig. 12, and Plate XXVIII, Fig. 27.) Described from two examples taken in Poudre Canon, Colorado, Sept. 19, 1920, and three examples in Ft. Collins foothills,[3] Oct. 9, 1917, by L. C. Bragg.

Color: same as viviparous female.

Measurements: body, 3–3.5 mm.; wing, 3.5–3.9 mm.; hind tibia, 2 mm.; antenna, 1.4 mm.; joints of the same as follows: III, .52–.57 mm.; IV, .23–.28 mm.; V, .28–.31 mm.; VI, .14 + .04 mm.; secondary sensoria as follows: III, about 60; IV, 17–23; V, 10. Hairs on hind tibia fine, rather numerous, at an angle of 30–45 degrees, .05 mm. in length, about the same as the diameter of tibia. Cornicles .20 mm. in diameter at base of cone. Wing venation and other characters as in alate viviparæ.

Apterous Oviparous Female (Plate XXVIII, Fig. 28.) Described from nine examples taken with second collection of males above mentioned.

Same in color and appearance as apterous viviparæ, but with great variation in size, 3–5 mm. in length; hind tibia, 2–3.5 mm. Hind tibia slightly swollen and covered with numerous small sensoria.

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[1]Altitude, 5,600 feet.
[2]Altitude, 8,000 feet.
[3]Altitude, 6,000 feet.

Collections were taken as follows, all on bark of twigs and small branches of *Pinus scopulorum* (Engelm.) Lemmon., in Larimer County, Walsenberg and Salida, Colo.,[1] by L. C. Bragg, C. P. Gillette, F. C. Hottes, C. A. Bjurman, E. Bethel, and the author.

Egg (on needles): One collection, March 26.
Fundatrix or Stem Mother: Five collections, April 8 to May 4.
Apterous Summer Viviparous Female: Eighteen collections, May 13 to September 25.
Alate Summer Viviparous Female: Eight collections, May 13 to September 1.
Apterous Oviparous Female: Six collections, September 1[2] to October 22.[3]
Alate Male: Four collections, September 19 to October 22.

Eggs were found hatching March 30, 1922, in natural temperature house.[4] Mature fundatrices were found April 27, or 28 days after hatching. Mature individuals have been taken as early as April 8. Second generation, both alate and apterous, appeared May 13, or 14 days after birth. Sexuales were taken from September 1 to October 22.

This species is very common and is found in quite large colonies.

Note on Taxonomy.

This species resembles quite closely *Lachnus edulis* Wilson (described in an earlier page in the same volume). It differs, however, in the following particulars, namely, usually slightly shorter hairs, cornicles generally appearing larger, legs lacking the orange yellow color, femora more dusky; powdery markings on dorsum generally less confined to median line, and general color of body with more tendency to brown. The newly born differ in being straw yellow in color instead of brown. These characters, however, are not sharply drawn and overlapping occurs, but since they differ in food plants, in which respect the genus seems to be quite specific, it seems advisable to consider them as distinct species until they can be united by further study.

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[1]Altitude, 5,000 to 9,000 feet.
[2]Altitude, 7,000 feet.
[3]Altitude, 6,000 feet.
[4]Altitude, 5,000 feet.

EXPLANATION OF PLATES.

PLATE XXIV.

Lachnus pseudotsugæ Wilson. 1, fundatrix; 2, young summer viviparous female, 1st instar; 3, young viviparous female, later instars; 4, adult apterous summer viviparous female; 5, alate summer viviparous female; 6, apterous oviparous female; 7, alate male.

Lachnus taxifoliæ Swain. 8, newly hatched fundatrix; 9, adult fundatrix; 10, alate summer viviparous female; 11, apterous summer viviparous female, adult; 12, young summer viviparous female, 1st instar; 13, young summer viviparous female, 3d instar; 14, apterous oviparous female; 15, egg.

PLATE XXV.

Lachnus pseudotsugæ Wilson. 1, antenna of apterous summer viviparous female; 2, cornicle; 3, antenna of alate summer viviparous female; 4, middle of hind tibia of apterous summer viviparous female; 5, middle of hind tibia of alate summer viviparous female; 6, terminal joints of beak; 7, antenna of alate male; 8, hind tibia of oviparous female.

Lachnus taxifoliæ Swain. 9, antenna of oviparous female; 10, tibia of same; 11, antenna of alate male; 12, antenna of apterous summer viviparous female; 13, cornicle; 14, middle of hind tibia of apterous summer viviparous female; 15, terminal joints of beak; 16, antenna of alate summer viviparous female.

Lachnus occidentalis Davidson. 17, antenna of apterous summer viviparous female; 18, cornicle; 19, terminal joints of beak; 20, antenna of alate summer viviparous female; 21, middle of hind tibia of the same; 22, antenna of alate male; 23, hind tibia of oviparous female.

PLATE XXVI.

Lachnus occidentalis Davidson. 1, egg; 2, freshly laid egg; 3, newly hatched fundatrix; 4, adult fundatrix; 5, alate summer viviparous female; 6, apterous oviparous female.

Lachnus oregonensis Wilson. 7, young fundatrix, 1st instar; 8, adult fundatrix; 9, alate summer viviparous female; 10, apterous male; 11, apterous oviparous female; 12, freshly laid egg.

PLATE XXVII.

Lachnus edulis Wilson. 1, apterous oviparous female; 2, egg; 2a, needle with eggs; 3, newly hatched fundatrix; 4, young fundatrix, a few days old; 5, young summer viviparous female; 6, adult apterous summer viviparous female; 7, alate summer viviparous female.

Lachnus vandykei Wilson. 8, apterous summer viviparous female; 9, alate summer viviparous female; 10, apterous oviparous female; 11, apterous male.

PLATE XXVIII.

Lachnus oregonensis Wilson. 1, antenna of apterous summer viviparous female; 2, antenna of alate viviparous female; 3, terminal joints of beak; 4, middle of hind tibia of apterous summer viviparous female; 5, middle of hind tibia of alate viviparous female; 6, cornicle; 7, antenna of apterous male.

Lachnus edulis Wilson. 8, antenna of apterous summer viviparous female; 9, terminal joints of beak; 10, antenna of alate summer viviparous female; 11, middle of hind tibia of apterous summer viviparous female (same as alate); 12, cornicle; 13, antenna of alate male; 14, antenna of oviparous female; 15, hind tibia of the same.

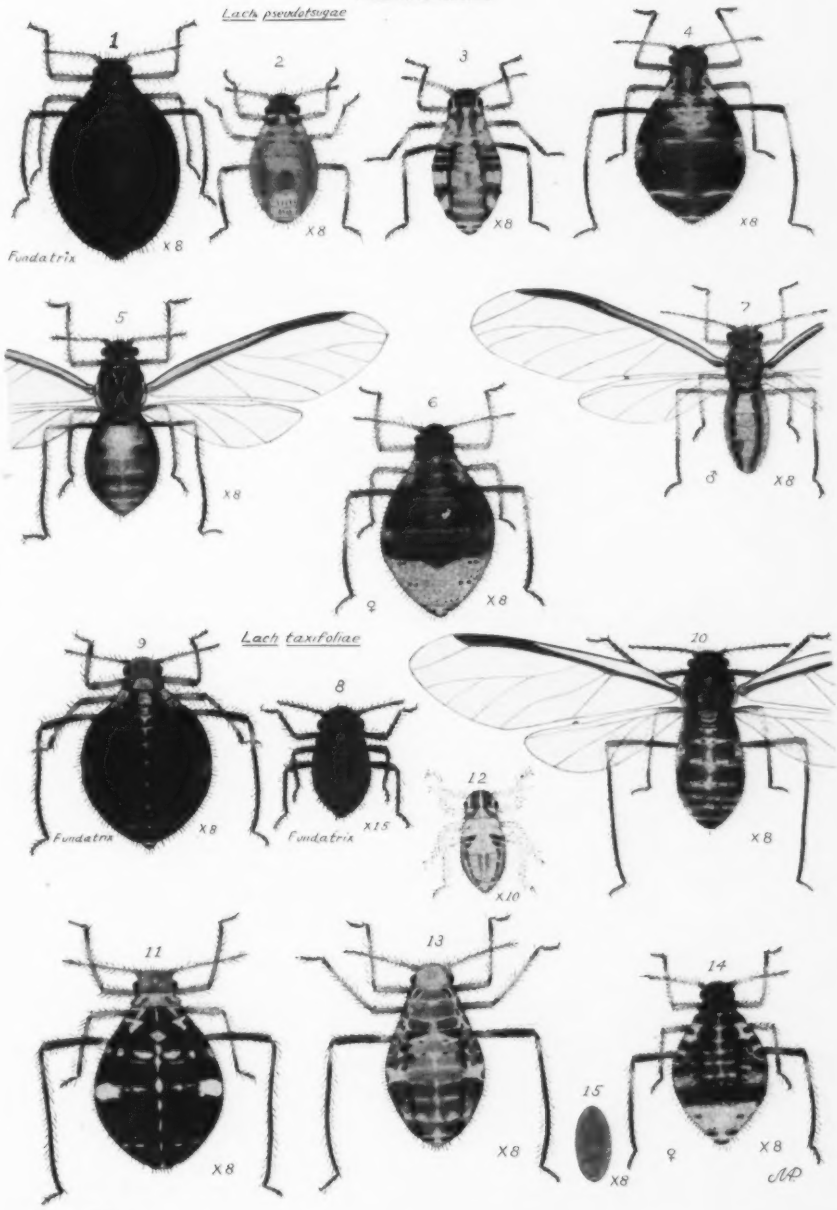
Lachnus vandykei Wilson. 16, antenna of alate summer viviparous female; 17, middle of hind tibia of the same; 18, antenna of apterous summer viviparous female; 19, terminal joints of beak; 20, hind tibia of oviparous female; 21, antenna of apterous male.

Lachnus schwarzii Wilson. 22, terminal joints of beak; 23, middle of hind tibia of apterous summer viviparous female; 24, antenna of apterous summer viviparous female; 25, cornicle; 26, antenna of alate summer viviparous female; 27, antenna of alate male; 28, hind tibia of apterous oviparous female.

PLATE XXIX.

Lachnus schwarzii Wilson. 1, portion of needle of *Pinus scopulorum* with eggs; 2, newly hatched fundatrix; 3, young fundatrix, a few days old; 4, same a few days older; 5, adult fundatrix; 6, young summer viviparous female, newly born; 7, young summer viviparous female, 3d instar; 8, young alate viviparous female, just before development of wing pads; 9, same showing wing pads; 10, alate summer viviparous female; 11, adult apterous summer viviparous female; 12, alate male.

~~PLATE XIV~~



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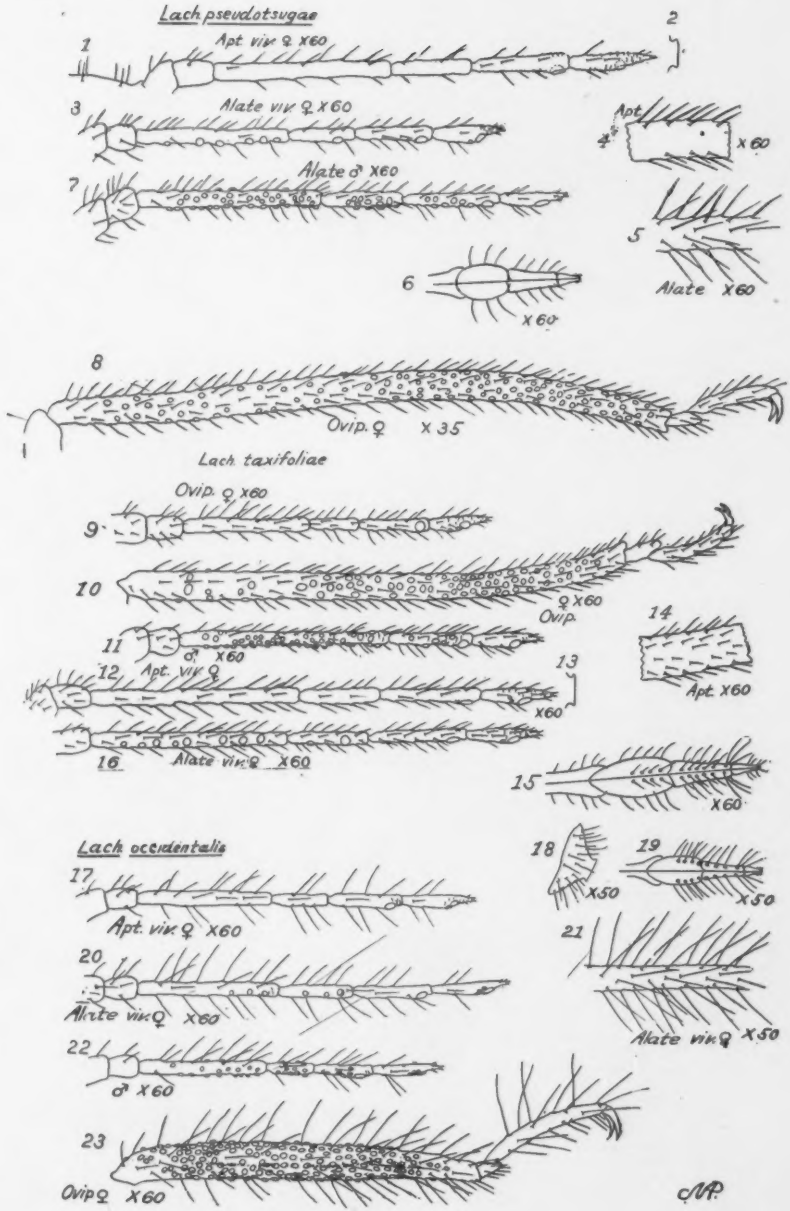
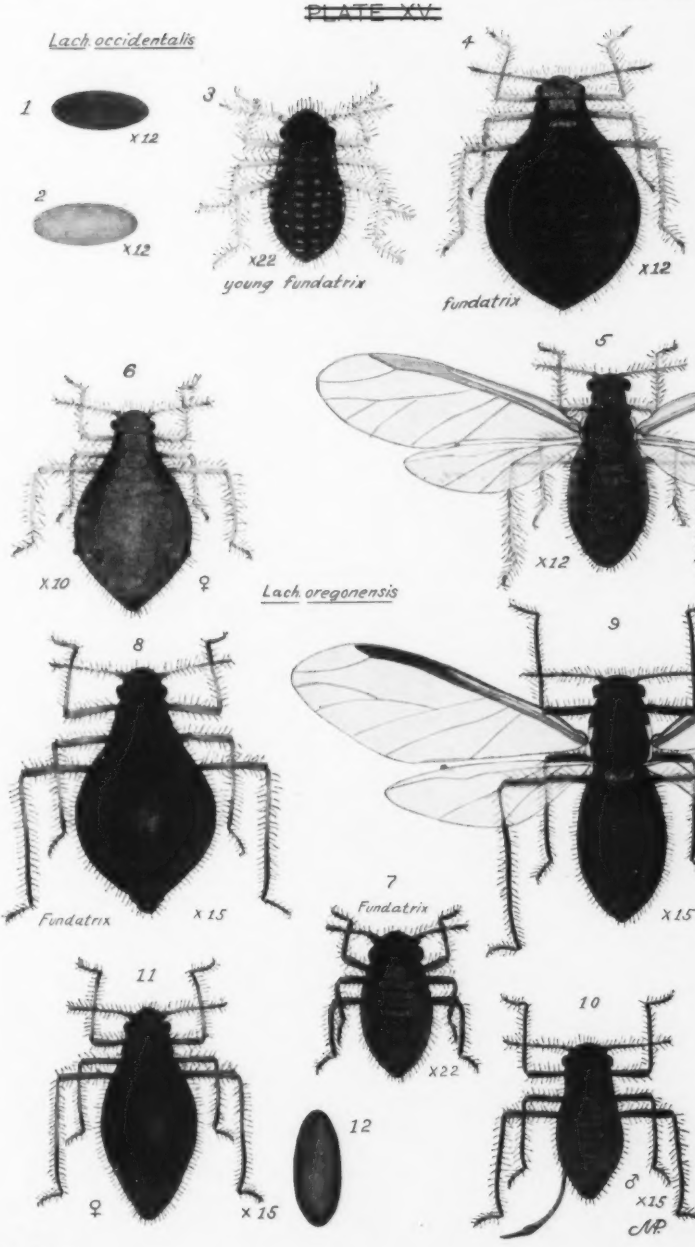

Lach. pseudotsugae
1
Apt. vir. ♀ X60
2
3
Alate vir. ♀ X60
4
Apt.
X60
7
Alate ♂ X60
5
Alate X60
6
X60
8
Ovip. ♀ X35
1
Lach. taxifoliae
Ovip. ♀ X60
9
10
♀ X60
Ovip.
14
11
♂ X60
Apt. X60
12
Apt. vir. ♀
13
X60
16
Alate vir. ♀ X60
15
X60
Lach. occidentalis
18
19
X50
X50
17
Apt. vir. ♀ X60
21
20
Alate vir. ♀ X60
Alate vir. ♀ X50
22
♂ X60
23
Ovip. ♀ X60
MP.

M. A. Palmer

~~PLATE XV~~



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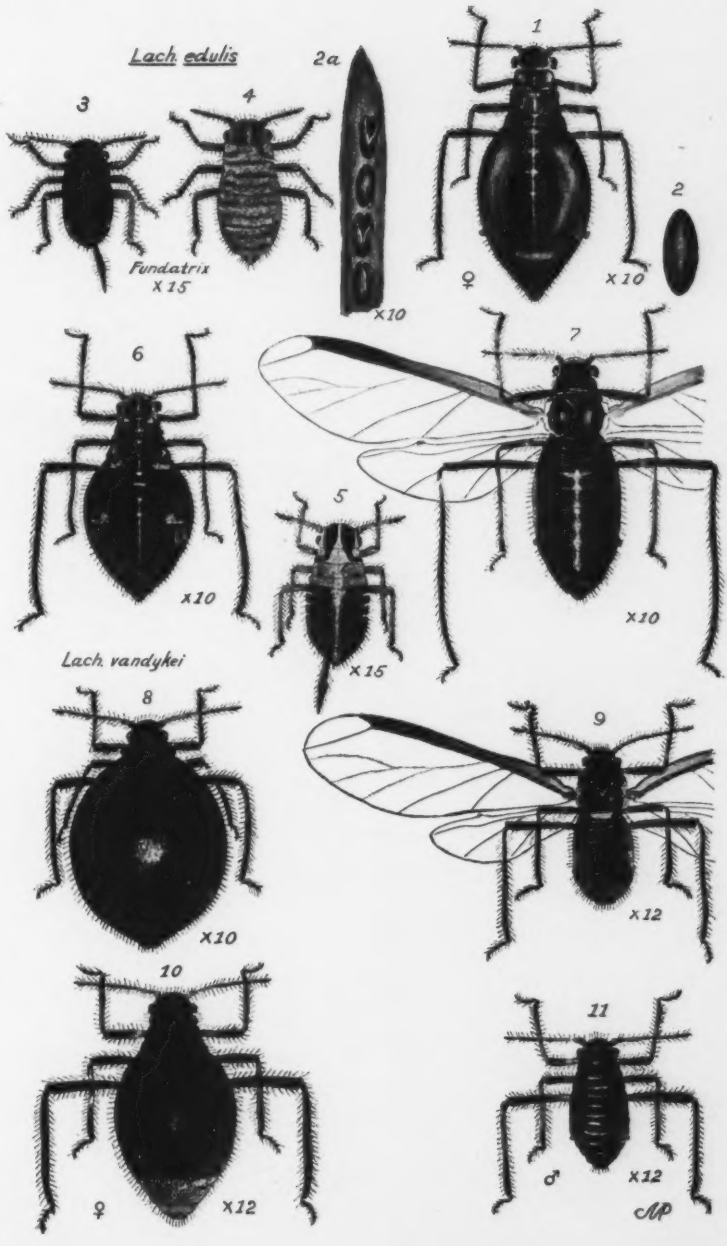
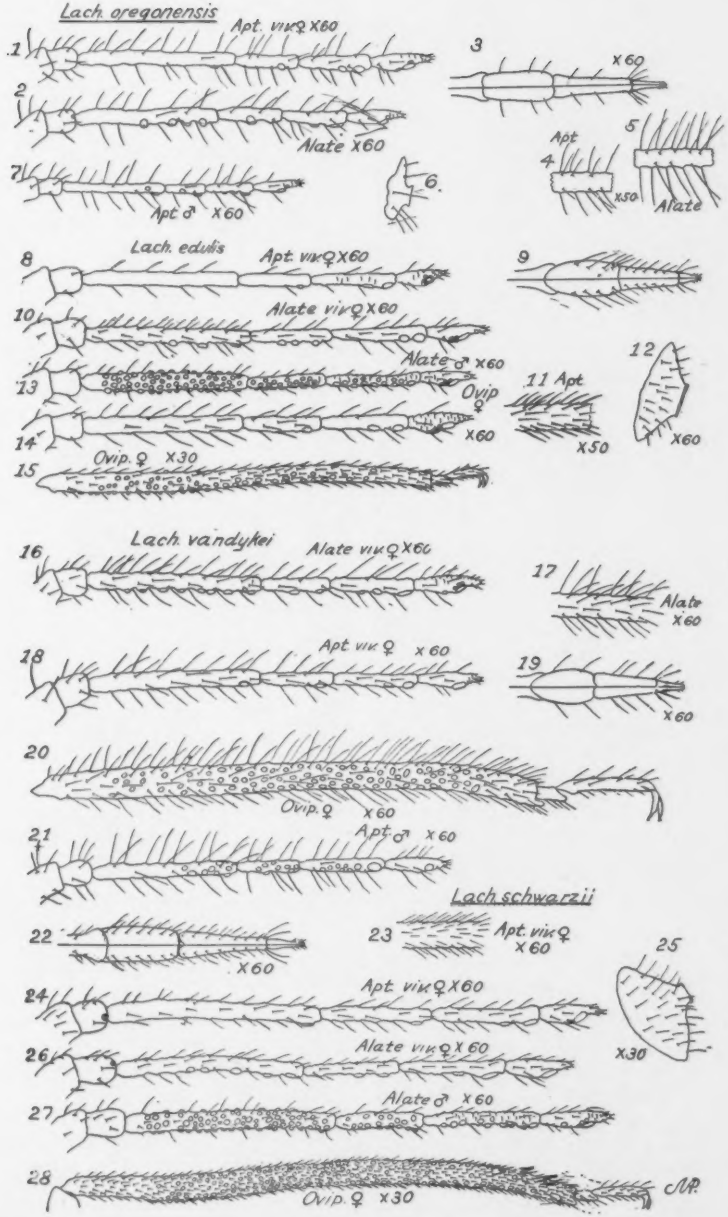
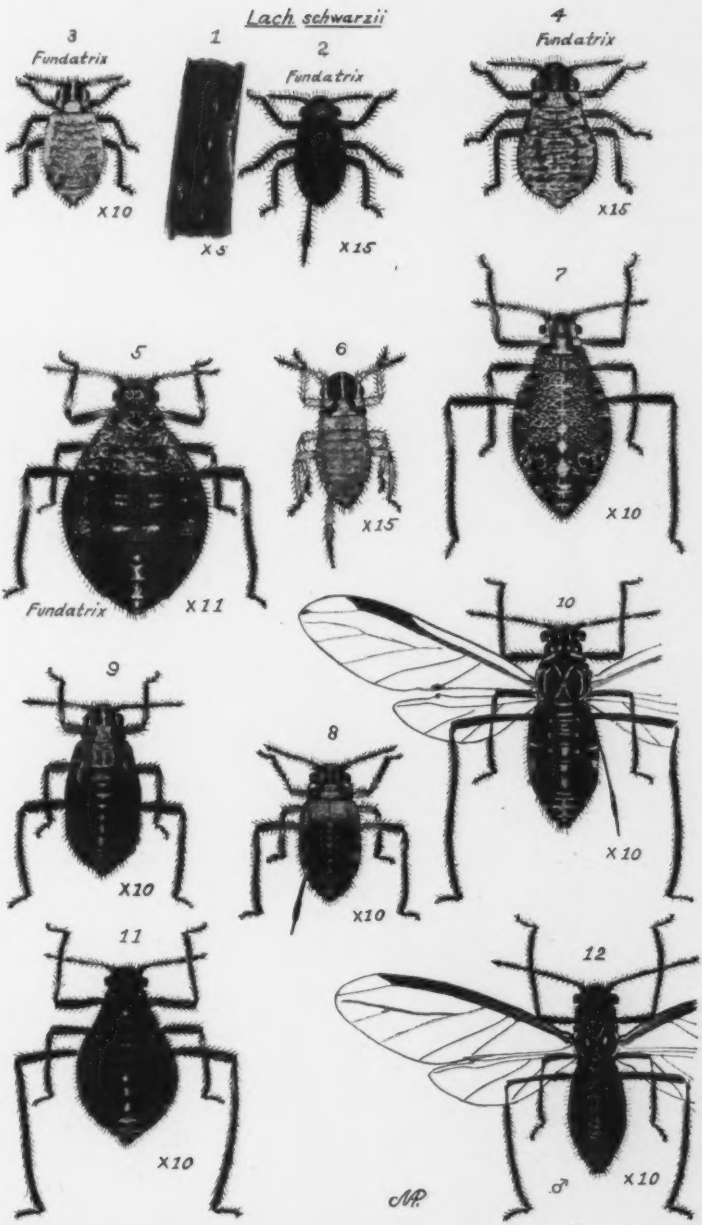

Lach. edulis
1
2a
3
4
2
Fundatrix
X 15
X10
♀
X 10
6
7
5
X10
X10
X 15
Lach. vandykei
8
9
X10
X12
10
11
♀
X12
♂
X12
MP

M. A. Palmer


Lach. oregonensis
Apt. vivi♀ X60
1
2
Alate X60
3
X60
4
Apt
X50
5
Alate
6.
7
Apt ♂ X60
Lach. edulis
8
Apt. vivi♀X60
9
10
Alate vivi♀X60
Alate ♂ X60
11 Apt.
X50
12
X60
13
Ovip ♀
14
X60
Ovip. ♀ X30
15
Lach. vandykei
16
Alate vivi♀X60
17
Alate
X60
Apt vivi ♀ X60
18
19
X60
20
Ovip.♀ X60
21
Apt ♂ X60
Lach. schwarzii
22
X60
23
Apt. vivi ♀
X60
25
X30
24
Apt. vivi♀X60
26
Alate vivi♀X60
27
Alate ♂ X60
28
Ovip. ♀ X30
M.P.

M. A. Palmer


Lach schwarzii
1
2
Fundatrix
X 15
X 5
3
Fundatrix
X 10
4
Fundatrix
X 15
5
Fundatrix
X 11
6
X 15
7
X 10
8
X 10
9
X 10
10
X 10
11
X 10
12
♂
X 10
M.P.

M. A. Palmer

NOTES ON SOME FEEDING HABITS OF TWO CHALCID PARASITES.

GRACE H. GRISWOLD,
Cornell University.

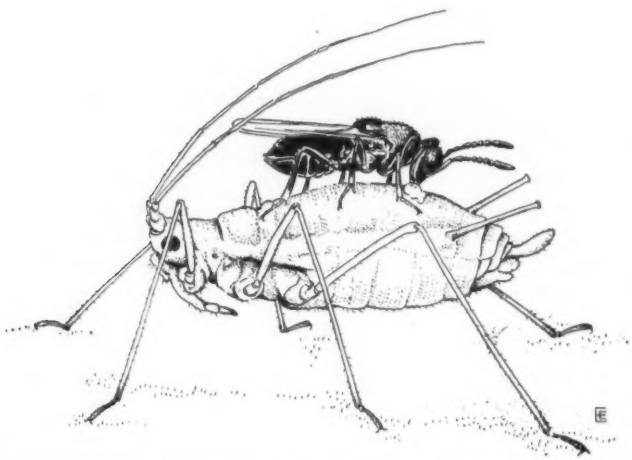
Marchal (1905) has recounted some interesting observations which he made on the oviposition habits of *Tetrastichus xanthomelaenæ* (Rond.), an egg parasite of the elm-leaf beetle *Galerucella xanthomelaena* Schr. This seems to be the first published record of a female chalcid having been seen feeding at puncture holes made by the ovipositor. In 1909 Marchal recounted observations of a similar character made on *Aphelinus mytilaspidis* Le B. when associated with the coccid *Aspidiotus ostreaeformis* Curt. Howard (1908, 1910) discusses the observations of Marchal, and predicts that this interesting habit "will be found to be quite widespread" among chalcidoids. Since the later article by Howard appeared, a number of workers have recorded similar observations in connection with various chalcid parasites. Among these workers are Quayle (1910), Doten (1911), Imms (1916), Rockwood (1917), Caffrey (1921), Hartley (1922), Cotton (1923), Lundie (1924), Crossman (1925), and Griswold (1925).

During the fall of 1925, in the greenhouse at the Insectary at Cornell University I reared two species of chalcids from the geranium aphid *Macrosiphum cornelli* Patch.* They were identified as *Aphidencyrtus inquisitor* (How.)† and *Aphelinus jucundus* Gahan.† Both of these parasites were observed to feed at holes made by the ovipositor, although the practice seemed much more common on the part of the former. In an effort to determine just how long a parasite might be kept alive on such a diet, the following experiment was conducted. Thirty females of each species were placed in individual vials such as are commonly used for rearing small parasites. Half of the insects were given fresh aphids every day, two aphids being furnished to each parasite. The remaining parasites were fed nothing whatsoever. It was found that the life of *Aphelinus*

* Determined through the courtesy of Edith M. Patch.
† Determined through the courtesy of A. B. Gahan.

jucundus could not be greatly prolonged in this manner. Fifteen of the specimens that were not fed had an average length of adult life of 6 days, the maximum being 7 days and the minimum 3 days. The individuals that were furnished with two fresh aphids every day showed an average length of adult life of 8.5 days, with a maximum of 12 days and a minimum of 3 days.

On the other hand, it was found that the life of *Aphidencyrtus inquisitor* could be greatly prolonged by such a diet.



Female *Aphidencyrtus inquisitor* (How.) feeding at an oviposition hole made in the abdomen of *Macrosiphum cornelli* Patch.

The fifteen females that were given no food whatever lived an average of 3.5 days, with a maximum of 5 days and a minimum of 2 days. As far as was observed, none of these individuals met with accidental death. The females that were given two fresh aphids each day lived an average adult life of 27.1+ days, with a maximum of 41+ days and a minimum of 3 days. The death of several of these individuals, however, was accidental, not natural. One individual got its wings stuck to a viscid droplet on an aphid's back, and so met its death at the end of three days. Two others became entangled in the cotton with which the mouth of each vial was plugged.

The experiment was begun on October 26, and daily observations were made from then until December 22, when it was

necessary to bring the experiment to a close. One *Aphidencyrtus inquisitor* was still alive on that date. It had emerged 41 days before.

At almost any time of day while the experiment was in progress, at least one *Aphidencyrtus inquisitor* could be found standing on the back of an aphid and either pushing in its ovipositor or feeding at the droplet of liquid which came from the hole where the ovipositor had been inserted. In no case did the aphid seem at all disturbed by either performance, and one was often seen walking about the vial for some minutes with a parasite perched on its back.

Aphelinus jucundus does not mount its victim when ready to make a feeding puncture, but goes at the process in quite a different way. Approaching the aphid in a somewhat stealthy manner, the parasite suddenly turns round and thrusts its ovipositor outward and upward into the aphid. It was noted that the ovipositor was inserted in almost any part of the aphid's body, even, as in one instance, in the front of the head just under the eye. But the result was found to be the same in every case. The aphid was always rendered helpless and eventually seemed unable to move. Although observed again and again, these aphids were never seen to revive and were always found dead in the vial the following morning. It was noted that the ovipositor might remain inserted for a considerable period of time. In one instance one was kept within an aphid for 7 minutes, was withdrawn, and was then at once reinserted for 8 minutes more. A tiny droplet would always appear at the oviposition hole, and to this the Aphelinus would apply its mouthparts, sometimes climbing all over the helpless aphid in an effort to reach its desired food.

In addition to the observations made on the fifteen females of each species that were furnished with aphids in this experiment, further observations were made at different times on other individuals of both species. In almost every instance the female *Aphidencyrtus inquisitor* would jump upon an aphid as soon as one was placed in the same vial with it. On the other hand, some time might elapse before a female *Aphelinus jucundus* would pay any attention to aphids placed in the same vial. It was found that Aphelinus females allowed to remain for a day or two without food would respond more quickly to the presence of an aphid than would females which had just emerged.

These observations add two more species to the steadily growing list of chalcids that have been seen feeding at puncture holes made by the ovipositor. The observations also show that this habit, at least in one instance, may be of considerable benefit to the parasite.

Macrosiphum cornelli n. sp. (Patch)

Winged viviparous female: Antenna with 20 (more or fewer) sensoria on segment III in single somewhat crowded row, IV and V without secondary sensoria, setæ blunt and shorter than one-half width of III. Abdomen yellowish green. Cornicle pale and almost unmarked, the faint scales at distal tip forming one to three indistinct rows. Cauda with 4 pairs of lateral hairs.

Wingless viviparous female: Antenna with 15 (more or fewer) sensoria in a row approximately the full length of III. Cornicle and cauda as in winged form. General body color yellowish green.

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FAUNISTIC AND ECOLOGIC NOTES ON CUBAN HOMOPTERA.*

HERBERT OSBORN.

The Tropical Plant Research Foundation of Washington, D. C., is conducting in Cuba an investigation of sugar cane production problems for the Cuba Sugar Club. This work is in charge of Local Director D. L. Van Dine and has its headquarters at the Cuba Sugar Club Experiment Station of the Foundation at Central Baraguá in the Province of Camaguey.

In connection with one of their important problems, the sugar cane mosaic, a disease known to be transmitted by *Aphis maidis*, the Foundation desired to ascertain the species of insects occurring in or around cane fields which by reason of their relationship and habitat might be suspected of being carriers of mosaic, and invited me to make a survey of the Cuban Homoptera as a basis for the disease transmission studies which are being made by Mr. C. F. Stahl, Entomologist of the Foundation.

The period from February 1 to March 31, 1925, was spent in Cuba. My collections were made with special reference to the forms of Homoptera associated with sugar cane diseases but included also various other ecological situations. Thus, while most time was spent on various sugar plantations in collecting insects from sugar cane and plants associated with it, many collections were made in pastures and meadows and in gardens and truck patches, so that a considerable variety of crops were covered. Comparatively little work was done in wooded sections and none in the higher mountains.

Geographically the trip extended as far west as Herradura in the Province of Pinar del Rio and east to Central Ermita and to Preston and Banes in the Province of Oriente.

Sugar cane in Cuba is grown mainly upon the lower elevations and much of it is but little above sea level, though planting is carried on in places over rolling land and foothills.

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* Paper No. 2 in the Scientific Contributions series of the Tropical Plant Research Foundation.

Ecologically, most Cuban cane fields occupy areas which were originally covered with a mixed hardwood forest. Some of the older regions in western Cuba were cleared generations ago, but in the central and eastern part of the country we collected in fields where the forest had been cut and burned and sugar cane planted within ten years or less. Occasional "Savannas" occur, where the predominant vegetation is grasses and scattered palms.

A discussion of the economic status of some of the more important species has been published elsewhere. (Osborn, '26.)

The region is in latitude 20° to 23°. It is distinctly tropical and it was a matter of considerable interest to compare the fauna with that of Central America and northern South America to both of which there is considerable affinity. It is notable that the island is by no means so abundantly supplied with species as the mainland either for southern United States or Central American region or South America and may be considered as being distinctly insular in character with close affinity to the other islands of the Antillean region. A detailed list of the species collected with notes concerning their ecologic and economic status is presented but it may be of interest to indicate some of the major ecologic groupings. First with reference to the species strictly associated with sugar cane it may be said that while there are but few species that can be considered as distinctly dependent upon sugar cane, there are a large number that by migration from grasses or adjacent plant societies may occur in considerable abundance and doubtless with economic importance to the sugar cane.

Of the species which occur normally upon cane or breed upon this plant we have *Stenocranus saccharicida*, *Eugnathodus guajanae*, and of those occurring commonly on cane but not restricted to it are noticeable *Cicadella similis*, *Deltocephalus flavicosta*, *Deltocephalus sonorus*, *Chlorotettix viridius*, *Oliarius franciscanus*, *Phasiocephalus cubanus*, *Tomaspis bicincta*.

The various grasses support a large number of species and as many of these may migrate to cane for part or all of their life stages they naturally constitute a very important grouping, especially as the mosaic disease may occur on a number of the grass species. Of the common grasses in Cuba, parana is one of the abundant species and on this is found a large variety

of leaf hoppers, some of the most conspicuous ones being *Cicadella similis*, *Euscelis obscurinervis*, *Draecuacephala mollipes*, some *Delphacids* and others less abundant. On a native grass, "Pitillo," are a number of what are evidently distinctly indigenous species, particularly *Chlorotettix viridius*, *Deltocephalus sps*, a species of *Ormenis*, and *Lepyronia angulifera*.

Guinea grass, which is an introduced species from Africa and used quite extensively as a pasture grass, is infested by *Spangbergiella vulnerata*, *Thamnotettix cubanas*, and *Deltocephalus flavicosta*.

A tall native grass called "barba de Indio" is interesting as a support of *Eugnathodus guajanæ* which occurs normally, and breeds, upon sugar cane.

A rather distinct ecologic unit is found in the tidal flats or "playas" which support an abundant growth of marsh grass and various sedges, bushes, etc. In these locations are found as common species, *Scaphoideus fasciatus*, *Deltocephalus littoralis*, *Draeculacephala sps*, *Cyrpoptus*, *sp.*, *Myndus enotatus*, *Bothriocera* sps, and several species of Delphacids.

Of the woods fauna for which comparatively few records were made there may be noted particularly *Cicadella histrio*, *Platymetopius* sp., *Agallia maculata*, *Cyrpoptus belfragii*, *Catonia rufula*.

A very interesting association was found in the needle clusters of the Cuban pine at Herradura from which I could secure by beating *Cyrpoptus belfragii*, *Catonia rufula*, *Agallia maculata*, *Scaphoideus bimarginatus*, and *Oliarus pinicolus*. All of these were apparently permanent residents of this particular association and particularly well adapted for living in this rather peculiar habitat.

A rather striking feature of the collections was the almost complete absence of Bythoscopidæ, very likely due to the season; the small number of species of *Cicadella* as compared with what may be found in the South American fauna and also the small number of Typlocybids, which should be more abundant in summer. On the other hand, the Jassinæ were quite numerous.

Considering the accessibility of Cuba there has been but little work done on the Homoptera, much less in fact than for some of the neighboring islands of the Antilles. Scattering

descriptions based on specimens from Cuba appear in the writings of Guerin ('56), Walker, ('52 and '58), Spangberg ('78), Stål ('69), Uhler ('64 and '95), Signoret ('52), VanDuzee ('07), Melichar ('01 and '06), Baker ('99), Crawford ('12), Wolcott and DeLong ('23), and the recent catalogues by Metcalf and Bruner cover practically all that has been published hitherto. Undoubtedly more intense collecting covering all the ecologic habitats of the island and continued through all seasons of the year should result in large additions to the present list.

The grasses most frequently referred to in the following records and which may be mentioned by the common cuban name only are "pitillo" *Opilsmaenus hirtellus* (L.); Guinea grass, *Panicum maximum* Jacq.; Para or Parana, *Panicum barbinode* Trin.; Bermuda Grass; *Paspalum* spp. and Natal grass *Tricholaena rosea* (Nees).

The following grasses have been reported as host plants for the mosaic of sugar cane. Sugar cane; corn "maiz"; sorghum; grama pintada, *Echinochloa colonum;* foxtail, *Chaetochloa glauca;* goose grass, *Eleusine indica; Paspalum virgatum; Syntherisma sanguinale* and *digitata*.

I wish to express my appreciation of the many favors received from the officers of the Foundation and the Cuba sugar Club and the managers of the various centrals. I am especially indebted to the Local Director, Capt. D. L. VanDine and to Mr. C. F. Stahl who accompanied me on many of the collecting trips and have supplied additional material. I may mention also Messrs. J. S. Orme, Baraguá; E. S. Walker, Preston; James Hillary, Banes; B. B. Dewitt, Jatibonico; J. A. Pepper, Jobabo; V. Y. Medina, Ermita and Federico Poey, Jaronū, who were particularly helpful in arranging for me to reach desirable collecting grounds. Mr. Chas. Ballou very kindly arranged for me to see the collection at the Santiago de las Vegas Experiment Station and the Gundlach collection in Havana.

Type and paratype specimens of the species described as new and sets of the other species collected will be preserved in the National Museum and collection of the author.

CICADELLIDÆ.

Agallia maculata n. sp.

Head distinctly produced, vertex very short, hind border elevated merging into a projecting ridge toward center. Front slightly convex, ocelli distant from base, antennal pits narrow, cheeks angular, margins very thin. Pronotum much advanced before the eyes, sub-triangular, hind border truncate; elytral veins rather indistinct. Genitalia: Female, last ventral segment short, scarcely longer than preceding, truncate. Male, valve small, triangular; plates narrow, triangular, slightly acuminate.

Color: Light grey, almost white, with pale fuscous spots a little more extended or darker in male than in the female. Vertex with central fuscous line, a short oblique line each side and darker dot above the ocellus. Pronotum with two blackish points anteriorly, a faint brownish median line and two oblique dashes on the disk. The fuscous maculæ on the elytra are arranged in rather indefinite bands, the most distinct one behind the middle of the clavus, another at the tip of the clavus and the apical part mostly infuscated in the cells, with white nervures. The spots on the basal third are faintly grey in this part and distinctly whiter in appearance.

Length: Female, 3.25 mm. Male, 2.75 mm.

This very handsome and unique little species was beaten from the clusters of needles on pine twigs of the long leafed Cuban pine (Pinus cubana?) at Herradura, March 15–16, 1925. In this locality they were associated with species of *Cyrpoptus*, *Oliarus*, *Catonia* and *Scaphoideus bimarginatus*. As the species was not taken at any other point and only in this particular habitat it seems it must be its natural food plant, possibly a distinctly restricted host, and must occur in considerable abundance, although it requires hard beating to dislodge them from their concealment in the needle clusters.

Agallia albidula Uhl. Baraguá, Feb. 6, in company or batey garden on carrot. Jobabo, Feb. 9, 10, 12; Preston, Feb. 20; Jaronū, Feb. 24; Herradura, Mar. 14. This species was described from St. Vincent, of the Lesser Antilles, and appears to be a common species in tropical America occurring from Brazil to Cuba. It has been taken from various plants other than grasses, but a definite host plant has not been determined. Recorded as tenella Ball in Wolcott's list for Porto Rico.

Agallia scortea Van D. Jobabo, Feb. 14. Taken at roadside in beating bushes, agrees closely with the description by Van Duzee (1907) in Jamaican Hemiptera.

Agallia pepino Wolcott and DeLong. Jobabo, Feb. 10, 12, from grassy lane especially from a broad leaf plant in pasture. Ermita, Feb. 17, in wood bordering cane and on garden shrubs. Baraguá,

Mar. 2, from Citrus trees; Mar. 3, low places in palm grove. Not taken in cane fields and probably not important in connection with cane culture.

Agallia 4-punctata (Prov.). Noted for the Island, but not taken during my winter stay.

Agallia constricta Van D. Hershey, Mar. 18. Calabazan, April 20 (Hine). Common and injurious to leguminous plants in U. S.

Agallia sanguinolenta (Prov.). Jobabo, Native plant in grass; Ermita, Feb. 17, in cane fields on a cruciform weed resembling pepper grass. No record of actual occurrence on cane. A species of very wide distribution in the U. S. and sub-tropical America. Often a serious pest in clover and for other legumes, but not commonly troublesome to grass crops.

Bythoscopus robustus (Uhl.) Ermita, Feb. 16, on "Ragweed." Cunagua, Feb. 25. Evidently quite scarce at this season and apparently associated with plants other than grass or cane.

Cicadella sanguinicollis (Sign.) No record except the original description from Cuba.

Cicadella sirena (Stål.). Ermita, Feb. 16, Croton bush, numerous; Feb. 17, wood bordering cane; Preston, Feb. 19; Banes, Feb. 21; Jaronū, Feb. 27, bushes in cane land. Wolcott records it from sugar cane and gramma grass, but I have not found it on grasses or in cane separate from woody plants.

Cicadella histrio (Fab.) (=robusta Walk. Sign.). Collected from a small tree at Jatibonico, Mar. 11. Very similar to sirena Stål, but the lines on the elytra are interrupted and the picture of the vertex and face somewhat different.

Cicadella similis (Walk.). Baraguá, Feb. 5, 7, Mar. 1, 2, 3, 4; Jobabo, Feb. 12, 15; Ermita, Feb. 16, 17; Preston, Feb. 19, 20; Banes, Feb. 21; Jaronū, Feb. 23, 24; Cunagua, Feb. 25; Jatibonico, Mar. 9 and 11; Herradura, Mar. 13 and 15; Hershey, Mar. 18. This is one of the most abundant species to be met with in the tropical parts of America ranging from the southern part of the United States through Central America, West Indies and South America. It is found on a large number of grasses, but is particularly common on the Parana and Guinea grass and some of the native species of the region. It also occurs in cane fields, but has been taken more particularly on young cane, and doubtless makes excursions into the cane fields at times when the native vegetation is less succulent and attractive. It has been taken at every locality where collections have been made, and occurs on a great variety of plants not only in the fields, but also along roadsides, gullies, arroyas, etc.

Considering the abundance of the species and its wide range of food habit, there seems to be good reason to consider it a possible carrier of plant diseases and it deserves careful experimentation to determine its possible relationship to mosaic in cane. So far, I understand, experiments have been negative, but there is, of course, a possibility of its being a carrier under suitable conditions.

Kolla hartii (Ball). Baraguá, Feb. 5. On grass adjacent to cane. Guinea grass. Herradura, Mar. 16. This is a common species in the southern U. S., but has been collected only at Baraguá and Herradura, in Cuba. It is a grass feeding species and if found to have wider distribution may deserve attention as of economic importance.

Kolla fasciata (Walk). Ermita, Feb. 16, 25, on lawn and in grass along railroad; Banes, Feb. 21, Mex. grass and weeds. A common species for tropical and sub-tropical America; certainly injurious to grasses, but not noted in cane.

Kolla geometrica (Sign.). A neotropical species, not taken during my stay in Cuba, but recorded from Gundlach Collection.

Draeculacephala sagittifera (Uhler). This is another very abundant species and is common to the West Indian region, occurring particularly in Bermuda grass, but is also found on other species, and frequently along the roadways adjacent to cane. Records are for Baraguá, Feb. 5; Jobabo, Feb. 16, 17; Preston, Feb. 19, Banes, Feb. 21; Jaronū, Feb. 23 and 24; Cunagua, Feb. 25; Jatibonico, Mar. 10, 11; Herradura, Mar. 15; Hershey, Mar. 18; Santiago de les Vegas, Mar. 19. It was found to be particularly abundant at Cunagua in a stand of nearly pure Bermuda grass in a roadway.

Draeculacephala reticulata (Sign). Described from Cuba and listed in collection of the Experiment Station, but none were collected during my visit. It seems peculiar that no specimens were taken in Cuba, but so far as my collections show, it is entirely replaced by sagittifera. Collected at Paradise Key, Fla., on Bermuda grass.

Draeculacephala mollipes (Say). Baraguá. Abundant on Panicum barbinodum, along railway on Feb. 5, also nymphs. Not as plenty as C. similis. On various grasses. One taken in field of Natal Grass, but not on this grass; Jobabo, Feb. 12, on rank grass, P. Barbinode? Feb. 9 and 10; Preston, Feb. 20; Banes, Feb. 21; Jaronū, Feb. 23 and 24; Cunagua, Feb. 25. A very common species for U. S., West Indies, and Central America on rank grasses. Not taken on cane.

Draeculacephala mollipes var. **minor** (Walk). Baraguá, Mar. 2, 1925.

Gypona cubana n. sp. Head moderately wide, broadly subangulate; vertex scarcely longer at middle than next the eye, anterior border bluntly angular; ocelli before the middle, a little farther from each other than from eye; front slightly depressed at base, margins curved; clypeus nearly twice as long as width at base, slightly expanded at tip. Pronotum nearly three times as long as vertex, hind border scarcely emarginate. Elytra long tapering apically. Female last ventral segment slightly longer than preceding, bisinuate with broad median lobe margined with brown.

Color, chestnut brown, the vertex with six yellow suffused dots, pronotum with a series of four dots parallel to anterior border and two close to the eyes; four conspicuous dots on base of scutellum light yellow or ivory white; elytra with fuscous dots alternating with dull

yellowish; veins brown. Beneath yellow, front with lateral arcs of front, base of coxa, pleural spot, band on femora, tips of tibia and spines fuscous; pygofer brown; ovipositor blackish. Length, 8.5 mm.

One female (type) taken in woods at Jatibonico Feb. 10th, 1925. I have also a female (paratype) from Holguin, Dec. 17, 1904. It is barely possible this may be the female of *annulipes* Spg., described from male, but there seems too great disparity in size to refer it to that species without more evidence.

Gypona albimaculata n. sp. Head broad, evenly rounded before; vertex a little longer at middle than at eye; ocelli scarcely before middle, less than twice as far from each other as from eye, twice as far from each other as from base; front flattened; pronotum two and a half times as long as vertex; elytra narrowing apically. Male last ventral segment as long as preceding truncate; plates fairly broad, widening at base, tapering gradually to blunt spoon-shaped tips.

Color, pale gray, irregularly spotted with white and punctured and dotted with fuscous; anterior femora and tibiæ twice banded with fuscous; hind tibiæ with fuscous margin and dots at base of spines; front brown with central spot and lateral arcs yellow; clypeus with whitish Y-mark; margin of loræ and spot on cheek pale yellow. Length, 9 mm.

Two specimens Boriato, Cuba, Feb. 7, 1904, (type and paratype) also one male (paratype), Soledad "10 III 1925," J. G. Myers.

Xerophloea viridis (Fabr.). Jobabo, Feb. 10, 12; Ermita, Feb. 17, from weeds and grass in roadway and in cane field; Preston, Feb. 19 and 20; Banes, Feb. 20; Jaronū, Feb. 23 and 24; Cunagua, Feb. 25. A common widely distributed species occurring from southern S. Am. through the tropics to northern U. S. Occurs on a great variety of grasses and doubtless feeds on many different species. Has been taken at practically all localities in Cuba where collections have been made, but at no place in great abundance and only in adult stage or with few exceptions. It evidently lives throughout the "winter" in Cuba as adult.

On account of its very wide dispersal in cane growing regions and its occurrence in grass and weedy areas adjacent to cane fields, it would seem a favorable species for distributing diseases, but its infrequent occurrence on cane itself would give it less apparent importance in this respect.

Xestocephalus pulicarius Van Duzee. This species is widely distributed throughout the United States and tropical America and appears to live on a variety of plants. It may be expected to occur as a common species in all parts of Cuba in favorable localities, but so far collected only at Banes, Feb. 21, where it was swept from coarse grass near the railroad, and at Baraguá, and on grass near the "playa."

Xestocephalus brunneus Van D. Ermita, Feb. 17; Preston, Feb. 19; Baraguá, Mar. 1. Beaten from Mango blossoms; Herradura, Mar. 14. This species has been recorded from widely scattered localities from Northern U. S. to South America. Specimens referred to this species have been taken at Jobabo (Stahl). Probably of general occurrence throughout the island. It does not appear to be of major importance in connection with plant diseases, but on account of general distribution may deserve some watching.

Xestocephalus tessellatus Van Duzee. Jatibonico, Mar. 10; Herradura, Mar. 14 and 15. This is another species of very wide distribution and sometimes occurring in abundance but probably on account of the season it was taken only rarely during my trip.

Spangbergiella vulnerata Uhler. Baraguá, Feb. 5, (playa) Feb. 7; Jobabo, Dec. 28 to 30, 1924, (Stahl), Feb. 11 on Guinea grass in pasture; Ermita, Feb. 17, on Guinea grass on roadway; Preston, on Guinea grass, Feb. 20 (playa); Banes, Feb. 21, coarse grass; Jaronū, Feb. 24, low ground coarse grass, Guinea? Jatibonico, Mar. 10. A large, handsome species, light green with oblique orange stripes on head and pronotum. Occurs generally on coarse grasses throughout southern U. S. and the tropical Americas. While common on coarse grass, especially Guinea grass, I have not taken it on sugar cane.

Scaphoideus fasciatus Osborn. Ermita on Lippia, Feb. 16 (Stahl); Preston, Feb. 20; Banes, Feb. 21, in grassland. A fairly common species in the West Indies and also recorded for southern U. S. No records of association with cane.

Scaphoideus bimarginatus DeLong. Ermita, Feb. 17, in canefield; Herrudura, Mar. 15 and 16, on pine trees. Described from Porto Rico, and not hitherto noted from any other region.

Platymetopius frontalis Van D. Ermita, Feb. 17; Herradura, Mar. 15. A very common species in the United States and south into tropics, but apparently much less common in Cuba at this season than loricatus. However, if it appears more common at other times of the year, it may deserve attention as a species of probably economic importance, especially as it occurs in meadows and pastures.

Platymetopius loricatus Van D. Baraguá, Feb. 5, in grass sweeping, yellow face, long vertex, Jobabo, Feb. 12; nymph? Pasture, Feb. 11; Ermita, Feb. 17; bushes in cane field; Preston, Feb. 19 and 20; Banes, Feb. 21; Jaronū, Feb. 23. Widely distributed and common, but generally associated with shrubs or woody plants.

Platymetopius nanus Van D. Preston, Feb. 20; Jatibonico, Mar. 10.

Platymetopius brevis Van D. Banes, Feb. 21; Hershey, Mar. 18.

Platymetopius limbatus n. sp. Head about as wide as pronotum, vertex long, about one-third longer than width between eyes, distinctly angulate, front four times as long as wide, narrowing nearly uniformly to clypeus; clypeus elongate, widened toward the apex; loræ long; cheeks with nearly straight margins. Pronotum about two-thirds as long as

vertex, emarginate behind; elytral veins distinct, about seven oblique cross-veins in costal area.

Female, last ventral segment narrow, produced, notched at tip; pygofer ciliate toward the tip; male, valve large, rounded behind, with a sub-marginal furrow; plates short, rounded at tips, ciliate on the margin, reaching about half way from tip of valve to apex of pygofer.

Color, olive green, mottled with fuscous, vertex with a discal darker area and apical patch including a broad whitish wedge; front fuscous, a narrow white line at base; elytra greenish fuscous on the inner border, the outer portion mostly hyaline except for the dark veins and the oblique cross-veins which are deeply fuscous, especially the nodal dash; apex narrowly white, with a sub-margin of fuscous; legs yellow, in the male tinged with red.

Described from two specimens, female (type), male (allotype), collected at Ermita, Feb. 17, 1925, from bushes or low herbage in woods. This is a very handsome little species, easily distinguished by the hyaline costal portion of the wing,

Deltocephalus trilobatus DeLong and Wolcott. Jobabo, Feb. 11, on Pitillo. Described from Porto Rico. Not taken commonly and probably of little economic importance.

Deltocephalus micarius Ball. Collected at Herradura, March 14. The species is fairly common in the southern U. S. in grasses of low ground or swampy tracts.

Deltocephalus balli Van D. Specimens referred to this species were taken by the writer at Baraguá, Feb. 5 and 6, Mar. 2, and also "at light" by Mr. C. F. Stahl, Oct. 23, 24, 25 and 27, 1925. Doubtful specimens were also taken at Jobabo, Feb. 12, and at some other localities. Balli is a widely distributed and destructive species in the United States affecting grasses and grains, but was not abundant enough to be counted injurious in Cuba and at no time was collected in cane. It is a quite variable species, but the Cuban specimens agree quite closely with some of the lighter colored individuals of the states.

Deltocephalus flaveolus n. sp. Head slightly wider than pronotum; vertex moderately flat, obtusely angular, one-third longer at middle than next the eye, wider than long, bluntly angular to front; front broad, lateral margins rounded; clypeus rather long, sides nearly parallel; loræ broad; cheeks slightly sinuate below the eye. Pronotum one-third longer than vertex, hind border scarcely concave. Elytra long, extended beyond tip of abdomen. Genitalia, female, last ventral segment long, narrowed posteriorly with a distinct notch at middle. Male, valve small, transverse, plates triangular, longer than broad, narrowing to sharp upturned tips. Color, bright yellow, face black with a few yellow points and indistinct arcs. Border of clavus and base of corium, fuscous. Apex beyond tip of clavus, smoky or infuscate. Beneath base of abdomen and the band on pygofer black, legs, except base of fore femora, yellowish. Length, female, 4 mm.; male, 3.2 mm.

Described from specimens taken at Herradura March 15, by the writer; Paso Real and Calabazar, April, 1924, by Prof. J. S. Hine. Also specimens taken at light, Baraguá by C. F. Stahl, October 24, 1925. These specimens show quite a little variation in the amount of coloring. The males usually being darker and the females lighter, some individuals having the face largely yellow, the front and loræ black, and the elytra a lighter fuscous with brassy reflection. The Herradura specimens were collected in numbers from a very rank grass in low land and a single specimen from near by *Paspalum*.

Deltocephalus albivenosus n. sp. Slender, head slightly wider than pronotum; vertex obtusely angular, nearly as long as width between eyes, one-fourth longer at middle than next the eye; front rather narrow; clypeus narrow, slightly narrowed at tip, loræ broad. Pronotum scarcely longer than vertex. Elytra long and slender, much longer than abdomen, veins conspicuous, middle anteapical cell divided. Female, last ventral segment long, narrowed behind, hind border truncate.

Color, brownish gray; vertex with four black points on anterior margin and milky whitish border next to the eye. Pronotum with five whitish stripes. Elytra with conspicuous ivory white veins. A patch in base of outer claval cell, the inner anteapical and two outer apical cells infuscate. Face black, the front with faint whitish arcs; loræ and clypeus white, the latter with blackish bands. Abdomen blackish. Ventral segment and pygofer light brown. Fore femora banded. Length, 4 mm.

One specimen Baragua, Cuba "at light" by C. F. Stahl.

Deltocephalus maculellus n. sp. Small, slender, head slightly wider than pronotum. Vertex bluntly angular, little wider than length at middle, one-fourth longer at middle than next eye, obtusely angular, the front narrow, tapering from antennæ to base of clypeus; clypeus long, sides parallel; loræ broad, extending nearly to margin of cheek; border of cheek distinctly sinuate. Pronotum one-fourth longer than vertex. Elytra exceeding abdomen, veins distinct. Female last ventral segment one-half longer than preceding, hind border very thin, slightly emarginate. Male valve triangular; plates broad at base, tapering to acute upturned tips, the margins ciliate.

Color, dull gray, vertex with two conspicuous black points at tip, two minute dots either side above the ocelli; face with two dots next the eye; front dusky with whitish arcs. Base of clypeus and upper border of loræ and inner streak on cheek blackish; pronotum with five pale stripes; elytra subhyaline, the base of outer claval cell, discal cell, and apex of all claval cells, the inner anteapical and two outer anteapical cells more or less infuscate; veins whitish, middle of costa faintly

yellowish. Beneath, venter yellowish, base of lateral margins and dots on tip of pygofer blackish. Length of female 3 mm. Male, 3 mm.

Described from specimens collected at Ermita, and Preston by the author and one specimen at light, Baragua, Cuba, C. F. Stahl. This species is very similar to *albivenosus* in general characters and color pattern, but aside from being slightly smaller, differs in the markings of the face, color of the abdomen and details of genitalia.

Deltocephalus marginellus n. sp. Broad, head distinctly wider than pronotum. Vertex short, scarcely angulate, twice as wide as length at middle, one-fourth longer at middle than next the eye; front broad, margins sinuate, narrowed to clypeus; clypeus long, sides nearly parallel; loræ broad. Pronotum one-half longer than vertex, concave behind. Elytra rather broad, distinctly exceeding abdomen. Genitalia; female last ventral segment a little longer than preceding, lateral angles somewhat longer, hind border sinuate, bluntly produced at middle with a black marginal spot either side. Male valve rather large, rounded in front, hind border nearly straight, plates short, about twice as long as valve, narrowed rather abruptly to bluntly rounded tips.

Color, pale fulvus. Vertex with two black spots at apex and a short brown line each side and a red margin next the eye; front black with light arcs; clypeus pale yellowish with a black median line expanded at tip; loræ and cheeks whitish; pronotum with five whitish stripes; elytra with whitish veins, the areoles margined with fuscous; legs pale, tips of femora blackish; venter of female brown, males, blackish. Length of female, 3.75 mm. Male, 3.25 mm.

Described from a series of specimens collected by the author at Herradura, March 14, '25.

Deltocephalus pellucidus n. sp. Head broad, rather short, obtusely angulate; vertex a little wider than long, one-fourth longer at middle than next the eye, obtusely angulate to the front; front slightly convex, narrowing from antennal pits to clypeus; clypeus nearly parallel sided; loræ rather small, cheek margins nearly straight. Pronotum about half longer than vertex scarcely concave behind, elytral veins distinct, middle ante-apical cell divided. Genitalia; female last ventral segment a little longer than preceding, outer angles rounded, median part faintly concave; male, valve long, rounded behind, plates short, triangular, tips sub-acute reaching tip of short pygofer.

Color: pale luteous, vertex and front unmarked or very faintly irrorate with whitish, pronotum with five faint whitish stripes, elytra sub-hyaline slightly infuscated, veins ivory white, basal half of costa light yellow, outer apical cell fuscous. Female segment broadly black on apical border. Male plates with a black spot at base, and on male black dash at each side of base of front.

Length: female, 3.5 mm.; male, 3 mm.

Described from specimens collected at Ermita, partly in woods, and cane fields, and one specimen on *Canatilla*, Feb. 17, 1925. These resemble pale specimens of *flavicosta* but are larger and the marking while very faint, appears different, so that it seems that they cannot be referred to that species. They resemble *flavicosta* in the yellow border of costa, the divided ante-apical cell, and the fuscous outer apical cell.

Deltocephalus lunatus n. sp. Head rather narrow, vertex as long as width between the eyes, distinctly angular, about one-third longer at middle than next the eye, front narrow, curved and tapering to clypeus; clypeus short and broad, parallel sided; loræ semi-circular; cheeks sinuate. Pronotum as long as vertex, truncate behind; elytral veins large, middle ante-apical narrow and divided at center. Genitalia; female, last ventral segment rounded, slightly notched at apex; male valve short, obtusely angular behind; plates narrow, triangular, exceeding the pygofer.

Color: dark fuscous, vertex with a broad yellowish median stripe expanding anteriorly to cover the apical part and including four black spots, the anterior ones touching the black base of the front; front mostly black or dark fuscous with a few whitish spots at base, a series of pale arcs and below a yellow lunate spot, the base of which touches the apex of front with the lower arm reaching the clypeus a little before the tip. Pronotum with five whitish stripes, four black points near the anterior margin; scutellum with two black dots at base, and fuscous median dash; elytra dark fuscous; veins broadly white, costa narrowly and very faintly yellow, the cells margined with fuscous, the two outer apical cells infuscated.

Length: female, 2.75 mm. Male, 2.5 mm.

Described from specimens collected at Jaronū, Feb. 24, 1925 from coarse grasses in low ground. This belongs with the *flavicosta* group, of which it might seem to be a variety but the pattern of the face, especially the lunate yellow spot, and the genitalia are sufficiently different to merit description.

Deltocephalus flavicosta Stål. Baraguá, Feb. 5, March 1, fairly common; Jobabo, (Stahl) Feb. 9 and 11, pasture (H. O.) Feb. 12, (H. O.) Ermita Feb. 16 and 17—common in grasses and canefield—taken on cane, also woods bordering cane with grass; Preston, Feb. 19 and 20—plenty on grass near cane; Banes, Feb. 21—plenty. Jaronū, Feb. 23 and 24—cane fields and grass; Jatibonico, March 9th and 11. Herradura, March 13–14–15. Cunagua, Feb. 25,—cane fields and grass. Fairly common on grass. Bermuda and on various grasses. It occurs from Argentina to Canada—a distinctly economic species, and should be studied as a possible agent in carrying mosaic and other plant disease. On sugar cane and "malojillo grass" (vide Wolcott). "Carrots" (Wolcott).

Deltocephalus littoralis Ball. Baraguá (Playa). Feb. 7, March 2. On tidal flats on salt marsh grass—only at or near tide level—common along Atlantic and Gulf coasts—probably submerged at times of high tide—probably of little economic importance unless the salt marsh grass on which it occurs is used as forage.

Deltocephalus obtectus O. & B. Swept from grass, Jobabo Feb. 11, Banes Feb. 21. Very close if not identical with our species. Not taken on Bermuda grass, which seems to be a common food plant in Florida.

Deltocephalus sonorus Ball. Baraguá, Feb. 5, March 2—not common, on *Panicum barbinode*—on Bermuda and Guinea grass. Jobabo, Feb. 9, sonorus (var.?) More distinctly marked than usual for U. S. species—pattern same—also found Feb. 12 and 25; Ermita, Feb. 17; Preston, Feb. 19; Banes, Feb. 21; Jaronū, Feb. 23; Jatibonico, March 10; Herradura, March 15.

Euscelis pallidus n. sp. Head slightly wider than pronotum. Vertex broad, more than twice as wide as length at middle, one-fourth longer at middle than next the eye, front broad, scarcely as wide as long. Clypeus narrowed to the tip; loræ large, nearly reaching border of cheek; cheek border distinctly sinuate. Pronotum nearly one-half longer than vertex, hind border scarcely concave. Elytral veins very indistinct. Male last ventral segment slightly longer than preceding, valve small, narrow, angulate behind; plates broad at base, narrowed nearly uniformly to acute tips, the border with a few stiff, brown bristles.

Color very pale yellowish, the ocelli and the outer angles of scutellum orange, the claval suture with a narrow brown line, the apical veins brownish toward tip. Otherwise elytra are clearly hyaline. Length, 3.25 mm.

Described from one specimen, male, Hershey, Cuba, March 18, 1925. This specimen is so light colored that it might be considered teneral, but some of the markings are distinct and the genitalia appear to be mature.

Euscelis obscurinervis (Stål) (E. exitiosa Uhl.). Baraguá, Feb. 5 and 6, Mar. 2 and 7, (in Bermuda grass and mixed grasses, both adults and nymphs); Jobabo, Feb. 9, 10 and 11, (mostly in Bermuda grass); Ermita, Feb. 16 and 17, (very abundant in all stages); Preston, Feb. 19 and 20; Banes, Feb. 21; Jaronū, Feb. 23; Jatibonico, Mar. 9 and 11; Herradura, Mar. 13 and 15; Hershey, Mar. 18; Santiago de las Vegas, Mar. 19. The species has not been observed on cane, but it is distributed very generally upon all kinds of grasses, some of which are known to harbor mosaic disease, so that the species may have a possible relationship in this connection. Its wide distribution and great abundance should make it a favorable bearer in case it is found to occur at times on cane.

Euscelis obtutus (Van D.). Baraguà, Feb. 5, sweeping mixed grasses; Jobabo, Feb. 11, pasture and mixed vegetation; Herradura,

Mar. 14. An extremely abundant species in southern United States, but not taken in large numbers in Cuba at any points where I collected. None recorded as occurring on cane. Widely distributed in U. S. and south.

Euscelis bicolor (Van D.). Baraguá, Feb. 7 and Mar. 2, (Playa), on grass near tidal flat; Jobabo, Feb. 12; Ermita, Feb. 17. A common and widely distributed species for tropical and north temperate America. Often abundant enough to be of economic importance. Not taken in cane fields, but common on grasses of various kinds.

Euscelis cuneatus Uhl. Baraguá, Mar. 2; Banes, Feb. 21. In grass.

Euscelis mexicanus O. & B. Jatibonico, Mar. 10. In grass.

Euscelis caudatus n. sp. Head decidedly conical, similar to bicolor; vertex one-third longer at middle than next the eye; front convex, narrow, about twice as long as wide; clypeus long; cheeks short. Pronotum almost as long as vertex, slightly concave behind, elytral veins distinct.

Vertex greenish yellow, with two large black spots near the tip; front, black, with pale arcs and a central pale line; clypeus greenish with a central fuscous spot; cheeks greenish, with fuscous dots; pronotum and scutellum olivaceous; elytra hyaline, tinged with olive, beneath black, margins of the segments greenish; pygofer and ovipositor black, margined with pale; tergum blackish on the disc, greenish-yellow on the margins; legs olive green, somewhat infuscate.

Female, last ventral segment slightly longer than the preceding, hind border truncate, pygofer elongate and exceeded by the ovipositor by nearly half its length. Length, female, 3 mm.

This species somewhat resembles *obtutus*, especially the forms which have distinctly hyaline elytra, but aside from the different picture on the vertex the ovipositor is more produced.

Described from a single specimen collected in rank grass at Jaronú, Cuba, Feb. 24th, 1925.

Phelpsius fuscipennis Van D. Baraguá, Feb. 7, (Playa); Hershey, Mar. 18; Herradura, Mar. 15 and 16; Paso Real, April 24 and 28, 1924, and Calabazar, April 30, 1924, (Hine). A common species in Eastern United States, New York to Florida and now recorded for Cuba.

Phelepsius cinereus Van D. My collection contains specimens collected by Mr. Robert Combs at or near Cienfuegos about the year 1895. Labels read only "Cuba Combs." This species occurs commonly in the United States from Texas to Florida and north to Kansas, Ohio, and North Carolina. The Cuban specimens average a little smaller, but do not seem to vary in other respects from the typical forms.

Acinopterus acuminatus Van D. Taken at Jobabo, Feb. 10, in patch of native grass (one specimen); Ermita, Feb. 17, on grassy roadway in cane field; Banes, Feb. 21 and 22, few. Widely distributed in southern

United States and in tropical America. Not abundant in any locality covered in this survey; apparently confined to native grasses.

Thamnotettix colonus (Uhl.). Baraguá, Feb. 5; Jobabo (Stahl), Feb. 12; Ermita, Feb. 17; Preston, Feb. 19, common; Banes, Feb. 21, common; Jaronū, Feb. 23 and 24, common; Cunagua, Feb. 26; Jatibonico, Mar. 10 and 11; Herradura, Mar. 13 and 15. A very common and widespread species in tropical America and north in the Gulf states. Especially common in Bermuda grass and on Paspalum. May be considered a possible carrier of plant diseases, and, on account of general distribution, an important species.

Thamnotettix nigrifrons Forbes. Preston, Feb. 20; Cunagua, Feb. 25; Jatibonico, Mar. 10; Hershey, Mar. 18. Mr. Stahl secured specimens at light Nov. 12, 1925. This is an abundant species throughout the eastern U. S. and apparently widely distributed in Cuba, but not found in cane. What appears to be a rather extreme variety has larger spots on the vertex and darker bands on the elytra.

Thamnotettix cubanus n. sp. Light yellowish with pale nervures, vertex with two large black spots and two minute points near the apex. Head slightly wider than pronotum, vertex nearly twice as wide as long, about one-third longer at middle than next the eye, sub-angulate to front; front oval, sutures distinct; clypeus elongate, sides nearly parallel; cheeks broad, sinuate beneath the eye. Pronotum half longer than vertex, uniformly curved in front, slightly concave behind; elytral venation distinct. Female, last ventral segment short, sinuate or excavated near the center. Male, valve rounded behind; plates short, sub-triangular, margins sinuate, tips bluntly rounded.

Color, light olivaceous yellow, pronotum a little darker than vertex, front with distinct fuscous arcs, and a clear whitish space on the middle, extending from near the base to the clypeus; elytra sub-hyaline, with faint metallic luster; veins whitish, and the cells faintly infuscate; costa white. Length of female, 4 mm.; male, 3 mm.

This species was taken quite commonly upon grasses at Baraguá, Jobabo, Banes, Jaronū, and other points, especially upon guinea grass. It is apparently quite closely related to *hyalinipennis*, a clear winged species, described from Rio Janeiro, Brazil, by Stal. It differs, however, in the frontal picture and in the arrangement of the vertex spots. Type specimens in author's collection and National Museum.

Chlorotettix viridius V. D. Baraguá, Feb. 25, in grass; Jobabo, Feb. 10, Mar. 2, native grass and salt marsh; Ermita, Feb. 16 and 17, grasses in and bordering cane fields; Preston, Feb. 19 and 20; Banes, Feb. 21; Jaronū, Feb. 23 and 24; Cunagua, Feb. 25; Jatibonico, Mar. 10 and 11; Herradura, Mar. 13 to 15. This species occurs throughout much of tropical America and north in the United States to the Great Lakes. Its wide range and grass feeding habit make it one of the important economic species, and, while not common on cane, it may distribute mosaic among grasses.

Chlorotettix minimus Baker. Baraguá, Feb. 5; Jobabo, Feb. 12; Ermita, Feb. 16; Preston, Feb. 19 and 20; Banes, Feb. 21; Jaronū, Feb. 23 and 24; Cunagua, Feb. 25; Jatibonico, Mar. 10 and 11; Herradura, Mar. 13 and 15. Commonly taken in sweeping grass.

Cicadula maidis De Long. Jobabo, Jan. 19 and 27, 1925 (Stahl), on corn, very plenty. Banes? This species recently described from Porto Rico occurs in all stages on corn, and, while this is evidently its normal host, it has been recorded by Wolcott from carrots and sugar cane. It therefore deserves attention in connection with the studies of possible carriers of mosaic.

Eugnathodus bisinuatus De Long. Baraguá, Feb. 5, Mar. 2, from grasses; Jobabo, Dec. 29, 1924, "Parana grass" (Stahl); Banes; Jaronū. On Natal grass?

Eugnathodus guajanæ De Long. Jobabo, Dec. 29, 1924 (Stahl); Parana grass; Ermita, Feb. 16, cane; Preston, Feb. 20; Banes, Feb. 21; Jaronū, Feb. 23 and 24, cane and "barba de Indio;" Cunagua, Feb. 25; Jatibonico, Mar. 11, 1925. This species is of special interest on account of its occurring in all stages in the "arrows" of sugar cane and apparently well adapted to the carrying of cane diseases.

Eugnathodus abdominalis Van D. Jobabo, Feb. 15, 1925, in grass adjacent to cane, possibly in cane, also taken on small bush in railroad right of way, the leaves showing severe puncturing.

Eugnathodus flavidus n. sp. Head slightly wider than pronotum, sub-angulate. Vertex short, scarcely longer at middle than next the eye; front broad, tapering from antennæ to clypeus; clypeus small, narrow at base, widening toward tip; loræ broad; cheek margin sinuate. Pronotum two and one-half times length of vertex, strongly arched in front, faintly concave behind. Elytra hyaline, veins distinct. Genitalia: female last ventral segment as long as preceding, truncate. Male valve short, transverse; plates small, triangular, tips acute and upturned.

Color, pale yellow with dashes of sulphur yellow on anterior border of pronotum and base of costa. Elytra milky hyaline with a tinge of orange in the discal cells and a fuscous stripe occupying most of the second apical cell. Wings milky hyaline with a clouded apical vein. Length, male and female, 3 mm.

Described from specimens collected at Jaronū, Feb. 24, 1925 from grass or sedge in the swampy habitat. This species is especially distinguished by the fuscous apical cell.

Eugnathodus virescens n. sp. Head slightly wider than pronotum, distinctly rounded in front. Vertex scarcely longer at middle than next the eye; front rather short, tapering from antennæ to base of clypeus; clypeus narrow, sides nearly parallel. Pronotum twice as long as vertex, moderately arched in front, hind border slightly concave. Elytra broad, veins distinct. Female last ventral segment a little longer than preceding, hind border slightly incised to form a central lobe. Male valve long, triangular; plates short, narrowed to bluntly rounded tips, extending to or beyond a short pygofer.

Color, light green; elytra greenish hyaline, abdomen yellowish green above, the borders of the segments distinctly yellowish; legs whitish. Length of male and female, 3 mm.

Described from specimens taken from grass at roadsides at Banes, Feb. 21, 1925.

Eugnathodus pallidus n. sp. Similar to abdominalis, but more pallid and dorsum of abdomen pale or with pale borders on the segments in male. Head scarcely wider than pronotum, rounded before. Vertex short, not longer at middle than next the eye; front tapering slightly nearly to base of clypeus, then contracting; clypeus long, sides parallel; loræ broad; cheek margins distinctly sinuate. Pronotum three times as long as vertex, distinctly arcuate in front, hind borders scarcely concave. Elytra long and narrow, veins distinct. Female last ventral segment about two times as long as preceding, hind border convex, faintly lobed at middle. Male valve long, angular behind; plates short, tapering to obtusely rounded apices, reaching tip of pygofer.

Color, pale olive green. Elytra milky hyaline, faintly infuscate in apical veins; female abdomen above, yellow or whitish, male dusky with whitish borders on segments or pale as in female. Length of female, 3.25 mm.; male, 3 mm.

Described from specimens collected at Preston, Rancho 8, Feb. 20, 1925. Quite similar to *virescens*. Elytra longer and coloration much lighter.

Balclutha hyalina n. sp. Head scarcely as wide as pronotum, rounded anteriorly; vertex as long at middle as next the eye, about four times as wide as long, front rather narrow, tapering slightly and abruptly narrowed to clypeus; clypeus narrow, sides parallel; loræ broad, cheek margins slightly sinuate. Pronotum a little more than twice as long as vertex, produced anteriorly, hind border nearly straight. Female last ventral segment one-half longer than preceding, truncate. Male valve large, rounded behind; plates small, scarcely longer than valve, triangular, the acute upturned tips extending a little more than half way to tip of pygofer.

Color, uniformly light gray with a faint tinge of rose, the vertex and scutellum a little suffused with white. Elytra milky hyaline, veins indistinct; wing veins distinct, apex slightly smoky; abdomen above dusky. Length of male and female, 3 mm.

Described from specimens collected from sedge at Jaronū, Feb. 24, 1925. This species has the appearance of *Eugnathodus*, but the head is narrower than pronotum. It is smaller and lacks the coloration of *impictus*. This and the species of Eugnathodus, particularly those on cane, have a special interest since the *Balclutha mbila* Naudé (1924) has been connected with the "streak disease" of corn in South Africa.

Protalebra cubana n. sp. Similar to terminata Baker, but smaller and the color pattern different. Head as wide as pronotum, distinctly produced, broadly rounded and slightly conical; face elongate, border of cheeks nearly straight. Pronotum about one-fourth longer than vertex. Male last ventral segment as long as preceding, truncate; valve wanting; plates elongate, tumid at base, slightly separated at middle, tips converging, bluntly pointed.

Color, light yellow, vertex and face almost white; pronotum with two broad, oblique, orange stripes near outer margin; elytra with golden spots at base, center and apex of clavus and on disc of corium; veins beyond clavus yellow, bordered with fuscous; the areoles hyaline with a broad, smoky patch at apex, margined with white; beneath pale yellow; legs whitish; plates with a black spot at center. Length, 2.5 mm.

Described from one specimen collected at Hershey, Cuba, March 18, 1925. This must be closely related to *terminata*, but it is much smaller and the color pattern differs in some important respects from examples I have of Baker's Brazilian species.

Protalebra braziliensis Baker. Baraguá, Feb. 5 and 6; Jobabo, Feb. 9; Ermita, Feb. 16 and 17; Preston, Feb. 19; Banes, Feb. 21; Jaronū, Feb. 25; Cunagua, Feb. 25; Jatibonico, Mar. 11; Herradura, Mar. 14; Hershey, Mar. 18. Abundant on a variety of plants, especially carrots and other vegetables in gardens. Often in mixed growth in and around cane fields. Specimens also from Mariango, Paso Real and Calabazar (J. S. Hine).

Protalebra similis Baker. Ermita, Feb. 16; Baraguá, Mar. 2; Herradura, Mar. 14. Not common and apparently of little economic importance in Cuba.

Protalebra maculata Baker. Rancho 8, Preston, Feb. 20, in grass. The species was described from Nicaragua and occurs in South America.

Empoasca fabæ Harr (=mali LeB.). Baraguà, Jobabo, Ermita, etc. A very common species ranging from Southern Canada to Argentina and known as the carrier of "hopper burn" in potatoes. It was noted especially on wild morning glory and sweet potatoes and while it feeds on a great variety of plants it is not known to attack cane or other members of the grass family.

Empoasca flavescens Fab. Jatibonico, Mar. 10; Herradura, Mar. 18. This is quite similar to fabæ and like it has a very wide range, but it was not observed as of as frequent occurrence in my collecting. It is not known to occur on cane or grasses.

Empoasca sp. Herradura, Mar. 14.

Typhlocybella minima Baker. Cunagua, Feb. 25; Baraguá, Mar. 7, (near Gloria); Jatibonico, Mar. 9 and 10; Herradura, Mar. 13. This is a very small species apparently rather abundant at times in grass but probably of no great economic importance. Recorded for Soledad by McAtee.

Just as this paper goes to the printer I have received the June number of the Journal of the New York Entomological Society containing an article by W. L. McAtee on Neotropical Eupteryginæ which includes records for a number of Cuban species including several described as new, most of them from specimens collected by Mr. J. G. Myers at Mina Carlota and Soledad. The following are not included in my records:

Dikraneura myersi McAtee. Soledad.
Dikraneura cruentata Gillette, Soledad.
Dikraneura debilis McAtee, Soledad; Mina Carlota, Trinidad Mts.
Dikraneura unipuncta Gillette. Soledad.
Dikraneura dorsalis DeLong. Mina Carlota, Trinidad Mts.
Joruma subaurata McAtee. Mina Carlota, Trinidad Mts.
Joruma peltata McAtee, Soledad.
Joruma semenula McAtee, Mina Carlota, Trinidad Mts.
Joruma atratula McAtee. Mina Carlota, Trinidad Mts.

No records of host plants for these species are given but there is no indication that any of them are found on sugar cane.

FULGORIDÆ

Dictyophara spinolæ (Auct?) In Gundlach coll. A species with long tapering vertex. Specimens agreeing very closely with the Gundlach specimen were taken at Baraguá (playa) Feb. 7th and at Jobabo Feb. 12 and 13, on coarse grass of low ground.

Dictyophara cultellator Walk? A specimen in my collection from Boriato, Feb. 12, '05, is referred to this species with some doubt. It was described by Walker from West Indies, "St. Domingo."

Pelitropis rotulata Van D. On Croton—Ermita, Feb. 16. One specimen. This stands in Cuban Collections as **Peliotropis mitratus** Uh., but is not given in Uhler's bibliography and is probably a MS. name used in reporting on Cuban collections.

Crypoptus belfragii Stål. Herradura March 15 and 16. Beaten from needles of long leafed Cuban pine, not abundant, some pairs. The males and females differ considerably in marking but I think there can be no question as to their relationship. Specimens in my collection also from Boriato, Dec. 2, '04 and Holguin, Dec. 19, '04.

Cyrpoptus obtusa Uhl. In collection of the Experiment Station at Santiago de las Vegas and the Gundlach collection. Similar to specimens collected from "wild tobacco." Preston, Feb. 20.

Oliarus franciscanus Stål. Baraguá, (Playa) Feb. 7, March 5, 7; Jobabo, Feb. 10, native grass; Ermita, Feb. 16; Preston, Feb. 19, 20; Banes, Feb. 21; Jaronū, Feb. 24; Jatibonico, March 9; Herradura, March 14, 15, 16. A very common and widely distributed species, ranging throughout most of the United States and from Atlantic to Pacific, the West Indies, and Central America, and on account of its abundance in grass land and cane fields, it may be considered as open to suspicion as a carrier of diseases occurring in plants upon which it feeds.

Oliarus pinicolus n. sp. Head narrower than pronotum. Vertex long, nearly twice as long as width between the eyes, projected distinctly before the eyes, distinctly depressed, front rather narrow, carinæ distinct. Pronotum short but distinctly visible, hind border deeply angulate. Scutum has five distinct carina, the mid-lateral ones curved. Elytra with veins distinctly punctate. Female last ventral segments narrow, ovipositor long, sharp. Male genital segment long with median spine, lateral borders expanded; plates broad, flat, widening apically and strongly recurved, forming a lyrate appearance.

Color: chestnut brown, the carina paler, elytra milkyhyaline, veins with conspicuous, alternating black and white dots, discal and apical transverse veins and tips of apical veins, infuscate, stigma fuscous with a whitish vein before and a denser line internally; face brown, the lateral angles and middle of clypeal carina a little paler. Length of female to tip of elytra, 7 mm. Male, 6 mm.

Described from a long series, sixteen females and eleven males, collected in the clusters of pine needles on the Cuban Pine at Herradura, Cuba, March 15 and 16, 1925. This species was taken in association with Cyrpoptus, Agallia and Scaphoideus and considering its abundance it seems likely to have an economic importance, especially if it should prove that nymphs live upon the same tree.

Bruchomorpha sp. Herradura Mar. 15, 16 '25. In grass land with ferns.

Catonia rufula n. sp. Head narrower than pronotum, vertex broad, about as long as wide, narrowed slightly toward the tip, front distinctly carinate, widening to near the clypeus; clypeus triangular carinate. Pronotum short, angulate with a distinct carina at the middle; mesonotum tricarinate; elytral veins strong, punctate, without cross veins except in the membraneous portion; apical cells nine, increasing in length to inner border.

Male, last segment with distinct central spine, plates broad, somewhat pearshaped, nearly meeting posteriorly.

Color: a dark brown, somewhat suffused with rufous; vertex and front minutely dotted with whitish; clypeus pale; pronotum and mesonotum minutely dotted; elytra sub-hyaline, veins distinctly reddish, membrane clouded with fuscous, and with a conspicuous row of submarginal fuscous spots in the apical cells. Wings smoky iridescent. Beneath paler, legs whitish, the tips of the hind femora tinged with reddish; tarsal claws blackish. Length: Male, 4.5 mm. To tip of abdomen 3.5 mm.

Described from a single specimen beaten from clusters of pine needles at Herradura, Feb. 16, 1925.

This species appears to be nearly related to *intricata* Uhl. but differs distinctly in markings and also in size.

Cubana tortrix Uhl. Recorded for Cuba by Uhler. ('95)

Cubana irrorata Uhl. Uhler's record refers to collection by Gundlach.

Cyarda melichari Van D. Banes, Feb. 21, on bushes "wild tobacco," in considerable numbers, and in border of wood and on bushes along ditch at side of railroad. At Herradura on small shrubby plant at roadsides. At Hershey in mixture of small shrubs and weeds.

Bothriocera undata (Fab.) Baraguá (Playa) Feb. 7 and March 2, grass, at near tide level; Banes, Feb. 21, Jaronū, Feb. 24; Jatibonico, March 9.

Bothriocera bicornis (Fab.) Jaronū, Feb. 24.

Myndus enotatus Van D. Baraguá, (Playa) Feb. 7 and March 2, grass at tidal flat and vicinity; Preston, tidal flat grass near Preston; Jaronū, Feb. 24, low ground, marshy. This is a very common and abundant species in the salt marsh grasses of the coastal flats of the south Atlantic and Gulf states as well as in the West Indies. None were taken in cane fields or pastures on higher ground.

Myndus crudus Van. D. Baraguá, Feb. 7 (Playa). Baraguá, March 2 at Playa tide level. Preston, Feb. 20, in coarse grass; Banes, Feb. 21, in course grass; Jaronū in coarse grass, Feb. 24; Herradura, March 15. One of the most common and widely distributed species occurring on grasses. Not taken, however, on sugar cane.

Ciocixius dorsivittatus Van. D. Baraguá, Oct. 5, 1925 "at light" (C. F. Stahl.) Described from Florida.

Vincentia interrupta Uhler. A male specimen in my collection which I refer to this species has "Cuba '05" as the only record. It is smaller than a female from Barbados referred to this species but seems to agree in all essential characters.

Phasiocephalus cubana Myers. Baraguá, Feb. 7; Jobabo, Dec. 29 (Stahl) Parana grass, Feb. , Ermita, Feb. 17 on cane and various plants around cane fields; Preston, Feb. 19, 20; Banes, Feb. 21; Jaronū, Feb. 23, 24; Cunagua, Feb. 25; Jatibonico, March 9, 10; Herradura, March 15; Hershey, March 18.

Recorded by Bruner (1922) under Phasiocephalus sp. as occurring in old cane fields.

A common species at all points and frequently taken in cane but occurring in a very great variety of locations and evidently a very migratory species and deserving attention as a possible carrier of plant diseases.

Cedusa inflata Ball. Preston, Feb. 20; Jatibonico, March 10; Baraguá, Oct. 24 (Stahl).

Cedusa obscura Ball? Jaronū, Feb. 24.

Cedusa sp. An unidentified species from Baraguá, Oct. 19 and Nov. 10, 1925, at light (Stahl) agrees closely with *vulgaris* Fitch, but only females are represented.

Amalopota fitchii Van D. Rio Cauto, Aug. 23–25, taken on sugar cane.

Cyphoceratops furcatus Uhler. Described as from Cuba. Not seen.

Acanalonia servillei Spin. Recorded by Guerin and there is a specimen in the Gundlach collection.

Acanalonia sublinea Walk. A specimen from Holguin, Jan. 3, '05, is placed here. It was described from St. Domingo and Melichar gives his **viridis** from Haiti as the same or very near.

Ormenis pruinosa Say. Ermita, Feb. 17. Boriato, Nov. 29, '04. A common species in the U. S., and evidently generally distributed in Cuba as it is recorded by Melichar but it was not taken in canefields or where there would seem to be opportunity for association with mosaic infested plants.

Ormenis contaminata Uhl. Uhler described this species from St. Vincent and Melichar lists it for Cuba. Specimens I place here are rather small but otherwise agree well with the original description. It was taken quite commonly, records including Preston, Cunagua, Baraguá and Jatibonico.

Ormenis sp. A very small species of this genus was taken at nearly every locality especially on the native grass Pitillo. It agrees closely with the description of **elevans** Walk, which Melichar has referred to **Colpoptera** but I am not aware of the reasons for such reference.

Flatoides punctatus Walk. Boriato, Feb. 12, '05 and April, '15. Baraguá, March 1. On Orange tree (Batey) Central Baraguá. A specimen of what is quite certainly the nymph of this species was taken at the same time and also beaten from orange tree though possibly from a different tree. It is depressed, the vertex short, deeply emarginate for reception of the much produced pronotum which is also short and deeply excavated for anterior production of mesonotum. The wing pads short, scarcely extended over outer part of first two abdominal segments; abdomen about as long as thorax, seven visible segments, the terminal one with divergent lobes on which is a pustulate area. Pronotum, mesonotum and bases of wing pads pustulate, wing pads with marginal dots blackish. Front sub-oval as broad as long, flat. Clypeus slightly elevated with shallow median furrow, antennæ cylindric joints about equal; seta as long as two basal joints together; legs short, minutely and faintly maculate; abdomen at tip pruinose or slightly cottony. Color, greenish gray with fuscous dots, eyes with same concentric brown lines as adult. Length, 3.2 mm. Width of pronotum nearly 2 mm., of abdomen, 15 mm. From appearance this may be 3rd or 4th instar. Melichar includes **acuta** Uhl. under this species.

Flatoides tortrix Guerin. A specimen in my collection of date "April, '05" is referred to this species. It is a very broad flat species and distinctly marked but is evidently rare or seldom taken. Its coloration and marking would protect it beautifully on bark or among lichens. The species also is represented in the Gundlach Collection.

Copicerus irroratus Schwarz. Baraguá, Feb. 6. Swept from carrots in garden; Jobabo (Stahl); Banes, Feb. 21; Jaronū, Feb. 24; Cuna-

gua, Feb. 25; Jatibonico, March 10. This is a common tropical species recorded from West Indies, Mexico and Central America but no records I have seen show it to occur in cane fields. It is more commonly taken from shrubs or localities where shrubs or woody plants occur.

Peregrinus maidis Ashm. Baraguá Feb. 6 in and near garden; Jobabo, Feb. 9. On potato near corn; Banes, Feb. 21, on Mexican grass; Herradura, March 15. This is the common species affecting corn and it has a very wide distribution, having been recorded from many of the southern states and also from Hawaii, Ceylon, South Africa, Porto Rico, etc. It is not found frequently on cane, but since it has been determined that it can transmit mosaic from corn to corn in Hawaii, it must be looked upon with suspicion.

Peregrinus cubana Crawf. The species was described by Crawford from specimens collected in the vicinity of Havana and I have specimens that fairly agree with his description but they may be only small specimens of **maidis.** The species is probably a grass feeder.

Stobaera tricarinata (Say). Jobabo, Feb. 10. Sweeping native grass near batey; Ermita, Feb. 16–17, in roadways or weeds; Preston, Feb. 19, on weeds; Banes, Feb. 21, on weeds and shrubs in thicket; Baraguá, March 2, on weeds. Some of the specimens secured were paler and smaller than the usual forms for the northern states and may constitute varieties but Crawford has grouped all such varieties under this species and they may be so indicated at least for the present. They do not appear to have any importance in canefields.

Stenocranus sacharivora Westw. Baraguá, Feb. 5, 7, March 2—Sabana Jobabo, March 9, 10, 11, on grasses and cane. Found also in pastures three or four kilometers from cane field on land never in cane; Ermita, in cane; Preston, in cane and grass; Banes, in cane and grass; Jaronū, in cane Feb. 24, also in grass; Cunagua, in cane and Feb. 25, also in grass; Jatibonico, March 10, 11; Herradura, March 14; Hershey, March 18. This is the common West Indian cane leaf hopper which has a wide distribution throughout tropical America, occurring in southern United States as well as in Central America and in the West Indian Islands. It is at times quite a serious pest upon cane but so far has not been demonstrated to carry the mosaic of sugar cane and grasses. It has been taken very commonly on grasses and sometimes at considerable distances, several miles, from cane fields which indicates that it has periods of quite general flight and may feed upon a variety of grasses. I have no records of its being found in the nymphal states on anything except sugar cane.

Stenocranus rostrifons Crawf. Cunagua, Feb. 25, on bunch grass near R. R.; Baraguá, March 2, on bunch grass; Paso Real (Hine 1924) apparently abundant on a single species of grass but not taken from any other plant. Probably does not fly so freely as *saccharivora*. This species is peculiar in the bent or flaring condition of the fore wings.

Stenocranus vittatus Stål. Jaronū, Feb. 24, on grass or sedge in low ground, common in Florida and Central America but not taken

commonly during my stay in Cuba. Probably not of particular importance in connection with the mosaic disease, at least for sugar cane.

Sogata aurantii (Crawf.) (**Stenocranus hinei** Dozier). Baraguá, Nov. 10, '25, "at light" (C. F. Stahl). Dozier's description was from specimens taken in Guatemala. The food plant is not known.

Sogata parvula n. sp. Head about as wide as pronotum, vertex short, scarcely longer than wide, carinæ rather blunt; front scarcely narrowed between the eyes, median carinæ distinct; lateral carinæ rather thin; pronotum nearly as long as vertex, lateral carinæ slightly curved and reaching hind border; scutellum with carinæ distinct; elytra much longer than abdomen; female plates broad.

Color: light brown, a distinct white stripe on vertex, pronotum and scutellum, and a lateral whitish stripe outside the carinæ on pronotum and scutellum. Margin of clavus white. Elytra with a smoky stripe, more intense on the membrane, the veins of which are terminated with fuscous spots; costal half of elytra whitish hyaline; face pale, unmarked; antennæ pale brownish, legs whitish; tips of tarsal claws brownish. Length: female 3.5 mm.

Described from one specimen collected on grass or sedge at Jaronū, Feb. 24, 1925. This agrees pretty closely with *S. aurantii*, but is smaller and lacks the black lines of the face.

Sogata cubana (Crawf.) Described from Havana specimens.

Euidella magnistylus (Crawf.) Credited to Cuba by Muir.

Eurysa dorsilinea (Van D.) Baraguá "at light." (C. F. Stahl).

Chloriona slossoni (Ball.) Baraguá Nov. 12, "at light" (C. F. Stahl.)

Delphacodes erectus var. **nigripennis** (Crawf.) Jobabo, Feb. 10, 12 and 13, on the native grass "pitillo" or in mixed grasses where this grass was present. The species occurred in rather small numbers and always where the pitillo was an element in the vegetation.

Delphacodes cultus (Van D.)? Herradura, March 15; Hershey, March 18, specimens are referred here with doubt as Mr. Muir seems to consider the species of doubtful validity.

Delphacodes havanæ Muir. Havana, (Muir.)

Delphacodes 4-spinosa Muir, Havana.

Delphacodes pellucida (Fabr.) Listed by Crawford and specimens referred here taken at Baraguá.

Delphacodes havanensis (Crawf.) The type locality is Havana.

Delphacodes cayamensis (Crawf.) Described from Cuba.

Delphacodes propinqua (Fieber). Muir includes under this species **terminalis** Van D., **tuckeri** Van Duzee and **erectus** (in part.) I took what I referred to **terminalis** at Jababo, Feb. 13; Ermita, Feb. 16; and Baraguá, Feb. 5; Preston, Feb. 20 "on Playa." **Tuckeri** as I placed it by comparison with specimen determined by Van Duzee was taken at Ermita, Feb. 16 and by Prof. Hine at Paso Real and Aquaducto in April, 1924.

Delphacodes puella (Van D.) Jobabo, Feb. 10, native grass "Pitillo;" Ermita, Feb. 16. This is a very small species common over a large part of the United States and ranging to the West Indies and into Central America, and probably of some importance in connection with grasses but not taken on cane, and probably not of special importance as a possible carrier of disease.

Delphacodes andromeda (Van D.) Jobabo, Feb. 10; Ermita, Feb. 16; Banes, Feb. 21; Jaronū, Feb. 23; Cunagua, Feb. 25; Jatibonico, March 10; Herradura, March 14, 15. This species has been taken at a number of locations in some places occurring in very large numbers, particularly on low growing grasses, *Paspalum*. On account of its abundance and wide distribution it might have a relation to the mosaic disease.

Delphacodes teapæ (Fowl.) Jobabo, Feb. 19, 20; Banes, Feb. 21; Jaronū, Feb. 23, 24; Cunagua, Feb. 25; Jatibonico, March 10; Herradura, March 14, 15. Like the preceding species, this has a very wide distribution occurring through Southern United States, Central America, and the West Indies, and is especially abundant upon various species of grasses. Of the minute hoppers this species would perhaps have the most significance as a possible carrier of mosaic. However, no evidence of this has been brought to light as yet.

Delphacodes albolineosa (Fowl.) Jobabo, Feb. 10; Preston, Feb. 24. This is another small species of subptropical distribution, occurring in Central America and the West Indies commonly, and sometimes abundant in grasses but is not as general or abundant as *teapæ*, though apparently quite similar in habits.

Membracidæ

But few members of this family were taken in locations adjacent to cane and probably none are to be considered important in relation to sugar culture.

Micrutalis calva Say. A common species in the U. S. and doubtless an abundant species in Cuba in proper season. It was taken at Ermita, Feb. 16th. Metcalf and Bruner record it for Santiago de las Vegas, Camaguey, Macanillo and Pico Turquino.

Stictocephala rotundata Stål. Taken at all points where I collected and evidently a common and abundant species throughout the island. Not associated with cane.

Monobelus flavidus Fairm. Collected at Banes, Feb. 21, '26. Metcalf and Bruner record it from Santiago de las Vegas, Nagua, Taco Taco and Candelero.

Idioderma picta, n. sp. A small species with distinct picture on pronotum. Head broad, face short, slightly rugose; clypeus small, elevated on center. Pronotum broad, with a faint carina, reaching nearly to tip of elytra. Elytra hyaline not coriaceous except at base of clavus, which is punctate. Pale yellowish green, the pronotum with a brown picture broad anteriorly with scattered yellowish dots,

a lunate band posteriorly touching margin each side and a few irregular splashes near apex. Beneath greenish yellow. Length 3.5 mm.

This very small species is decidedly distinct from any species I have ever seen.

Described from one male taken at Baraguá, Feb. 5, 1925. It differs from *varia* in being much smaller and in the color pattern.

The following additional species are included in the list by Metcalf and Bruner:*

Brachytalis fuscus M. & B. Pico Turquino, Sierra Maestra.

Brachytalis fuscoalis M. & B. Sierra Maestra.

Idioderma virescens Van F. Santiago de las Vegas and Bolondron.

Idioderma varia Van D. Santiago de las Vegas.

Enchotypa fairmairii Guerin. Havana, Santiago de las Vegas and Camaguey.

Enchotypa cocinna Fowler. Santiago de las Vegas.

Orthobelus havanensis Fairm. Nagua and Camaguey.

Orthobelus poeyi Fairm. Hoya, Colorado.

Goniolomus tricorniger, Stål. Camaguey.

Nessorhinus gracilis, n. sp. M. & B. Camaguey. July.

Monobelus fasciatus Fabricius. Pico Turquino and Sierra Maestra.

Monobelus lateralis Stål. "Cuba." Camaguey and Bolondron.

Monobelus turquinensis M. & B. Pico Turquino.

Monobelus niger M. & B. Camaguey and Taco Taco.

Monobelus irroratus M. & B.

Brachycentrotus punctatus M. & B.

Brachycentrotus hirsutus M. & B.

Tolania punctata M. & B.

Cercopidæ.

Tomaspis bicincta—(Say.) Var. fraterna Uhl. Banes—1924—on sugar cane (E. W. Russell Coll.), Preston, No. 48, in grass near cane; Banes; Jaronū, Feb. 24, low ground; Cunagua, —? Herradura, March 15. This is a very common insect for southern United States and the West Indies. Its occurrence in cane fields has been noted frequently enough so that it may be considered an important species. It occurs in grasses and probably feeds rather promiscuously upon different members of the grass family and considering its size and general distribution it would seem to be a suitable subject for careful observation in connection with the studies of mosaic carriers.

* Membracidae of Cuba. Bulletin, Brooklyn Entom. Soc., Dec., 1925, Vol. XX, pp. 203-214.

Lepyronia angulifera Uhl. Jobabo, Feb. 10, 11—on various plants "pitillo;" Banes, Feb. 21, very abundant in pasture with pitillo?; Jaronū, ?; Baraguá, March 2, Sabana; Jatibonico, March 14. The species is common to a large portion of sub-tropical America, but especially abundant in Cuba where it is found on a variety of grasses. particularly in tracts of grass land containing the common native grass, pitillo. No records have been made of its occurrence on sugar cane.

Clastoptera stolida Uhl. Jaronū, Feb. 24th, low ground. Baragua. The species was described many years ago by Uhler from specimens which he received from Poey. Our specimens agree very perfectly with the description so I think there can be no question as to their identity. The species was taken only in swampy ground upon low bushes and probably does not occur on plants closely related to cane.

Clastoptera undulata Uhl. Described from Cuba. Not seen.

The following species have been described as new by Metcalf and Bruner in their recent paper (1925) on the Cercopidæ of Cuba.

Monecphora flavifascia M. & B. Perico, Matanzas.

Leocomia grisea M. & B. Sierra Maestra.

Leocomia balloui M. & B. Pico Turquino.

Leocomia nagua M. & B. Nagua, Oriente.

Leocomia maestralis M. & B. Sierra Maestra.

Leocomia pileæ M. & B. Pico Turquino.

Leocomia fulva M. & B. Pico Turquino.

Enocomia maestralis M. & B. Sierra Maestra and Pico Turquino.

Dasyoptera variegata M. & B. Pico Turquino.

Lepyronia robusta M. & B. Santiago de las Vegas and Manzanillo.

Clastoptera flavidorsa M. & B. Sierra Maestra.

Clastoptera cuba M. & B. Palma Mocha Mt., Sierra Maestra.

Mr. J. G. Myers (1926) in a recent paper entitled "Dry Season Studies of Cane Homoptera at Soledad, Cuba," has discussed the following species:

Kolla similis, Dræculacephala minor, Oliarus franciscanus, Myndus crudus, Saccharodysne saccharivora, Pereginus maidis, Phasiocephalus cubanus, Aphis maidis, Sipha flava, Pseudococcus sacchari, Ripersia n. sp., *Targioni sacchari.*

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EXPLANATION OF PLATES

Plate XXX

Fig. 1. *Agallia maculata* n. sp. *a*, vertex and pronotum; *b*, face; *c*, female; *d*, male genitalia.

Fig. 2. *Platymetopius limbatus* n. sp. *a*, vertex and pronotum; *b*, face; *c*, female; *d*, male genitalia.

Fig. 3. *Deltocephalus lunatus* n. sp. *a*, vertex and pronotum; *b*, face; *c*, female; *d*, male, genitalia.

Fig. 4. *Deltocephalus flaveolus* n. sp. *a*, vertex and pronotum; *b*, face; *c*, female, *d*, male, genitalia.

(From drawings by D. G. Hall).

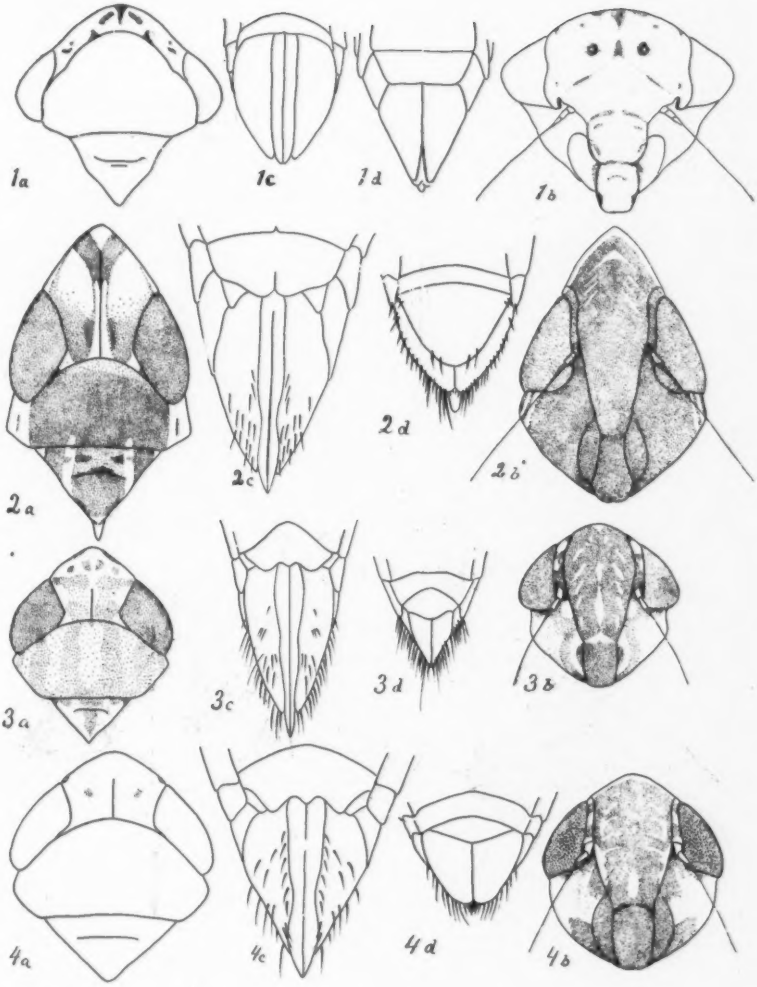
Plate XXXI

Fig. 5. *Euscelis caudatus* n. sp. *a*, vertex and pronotum; *b*, face; *c*, female genitalia.

Fig. 6. *Thamnotettix cubanus* n. sp. *a*, vertex and pronotum; *b*, face; *c*, female, *d*, male, genitalia.

Fig. 7. *Catonia rufula* n. sp. *a*, vertex and pronotum; *b*, face; *c*, male genitalia.

(From drawings by D. G. Hall).



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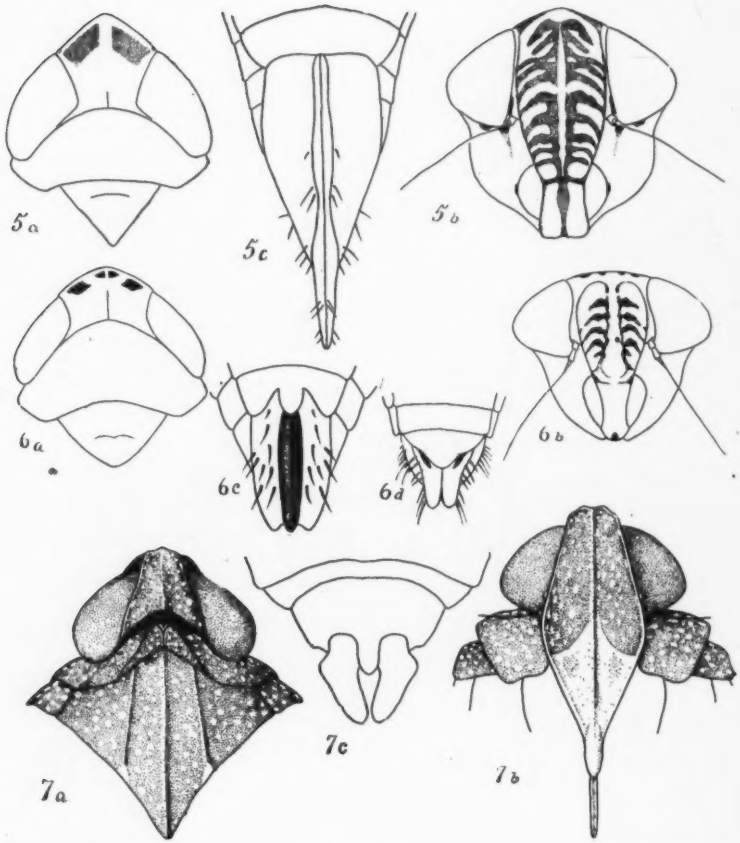

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